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AIRCRAFT ICING CLIMATOLOGY FOR THE NORTHERN HEMISPHERE

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13. ABSTRACT

This report is an update of the methodology used within the Air Weather Service to determine the climatological probability of aircraft icing throughout the Northern Hemisphere. It presents isopleth charts of the 1000-, 850-, 700-, and 500-mb surfaces for each of the twelve months. A station listing and locator chart gives the extensive areal coverage of the data used in the computerized calculations.

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PREFACE

This report was prepared originally by USAFETAC to answer a request from the Air Force Systems Command's Aeronautical Systems Division, through the 6WWg Staff Meteorologist, for information on the aircraft icing probabilities from near the surface up to 40,000 feet.

The Aeronautical Systems Division is interested in icing as it affects operational analyses for new systems and subsystems entering the Air Force inventory in the 1970's and beyond. To this end, 6WWg, OL-A, requested that USAFETAC extend AWSTR 194 from a three-level (5,000, 10,000, 15,000 ft) and seasonal analysis to one that more adequately covers the operational range of Air Force and DOD aircraft. USAFETAC invited 6WWg, 3WWg, and AWS personnel to meet at Washington, D. C. on 2 March 1971 to resolve potential differences of opinion regarding the optimum presentation of icing climatology. The attendees agreed that the methodology developed at USAFETAC has the advantage of utilizing the computer to produce data by month and for each pressure surface, and compiling potential-icing and probable-icing statistics utilizing techniques discussed in AWSM 105-39.

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Introduction

Since 1967 the Air Weather Service has been using the procedures set forth in AWSTR 194 and AWSM 105-39 to answer the many requests for the probability of aircraft (airframe) icing within the Northern Hemisphere. These procedures have proved valuable aids in satisfying the needs of our users. The basic concepts employed in the original reports as well as the actual icing observations made during 1952-1955 remain as the best approach to icing probability in the free atmosphere. This report is an update of these procedures encompassing additional data worldwide. This "updated" method was developed by the authors aided by personnel of the Environmental Technical Applications Branch of USAF-ETAC, Washington, D. C. In March 1971, a Conference on Airframe Icing Climatology was held at USAFETAC in Washington, D. C. This conference, attended by representatives from USAFETAC, 6WWg OL-A, and 3WWg, made recommendations that led to the adoption of the aircraft icing climatology method presented in this report.

Definitions and Assumptions

In general, the USAFETAC method for determining aircraft-icing probabilities is derived from techniques discussed in Attachment 1 to Air Weather Service Manual (AWSM) 105-39 [1]. Table 8, "Frequency of Aircraft Icing by Air Temperature and Dew-Point Spread," and Figure 16, "Graph of Cumulative Frequencies of Icing Occurrences as Functions of Temperature and Dew-Point Spread," from this attachment are reproduced in Appendix A of this report and remain an important part of the method used. In order for the reader to clearly understand the method, certain definitions and assumptions must be set forth.

a. This method still employs the empirical icing data gathered by USAF Air Weather Service (AWS) reconnaissance flights over the North Atlantic and North Pacific Oceans during May 1952 through June 1954, and over the Arctic Ocean during May 1952 through June 1955 [4]. It is assumed that this continues to be the best accumulated data available on actual aircraft icing in the atmosphere.

b. Radiosonde data from over 380 Northern Hemisphere stations were machine-processed and hydrostatically checked. These data were input <u>at face value</u>, regardless of the type of radiosonde instrument used or the potential errors inherent in the humidity sensors of these instruments.

c. The type and severity of the icing are not considered. From climatological records, this report determines only the probability that aircraft icing will occur above a given station during a given month.

d. Actual cloud observations are not considered as such. It is assumed

that clouds are present within the particular limits of temperature/dew-point spread as shown in Figure A-1, Appendix A. For purposes of this report, clouds are assumed to occur with the conditions as shown below the 95% curve on Figure A-1.

e. For icing to occur, free-air temperature must be -3°C or colder but no colder than -30°C. For the upper limit, our assumption considers the heat of friction of the air across the airframe. This friction is assumed to prevent the formation of aircraft ice at temperatures warmer than -3°C. For the lower limit, it is assumed that supercooled water rarely exists at temperatures colder than -30°C even though, under controlled conditions, liquid water is known to exist at temperatures as low as -40°C.

f. The occurrence of icing above 20,000 feet is assumed to be rare and approximated by the probability at 20,000 feet. Most of the icing that does occur is assumed to be found in the supercooled water droplets of towering cumulus or cumulonimbus cells. Therefore, the probabilities may be reduced even lower by avoiding flight into these clouds.

g. Probabilities of icing are presented only for the 1000-, 850-, 700-, and 500-mb surfaces because these are the only surfaces for which data were available for Northern Hemisphere analyses.

h. The probable icing values given in Figures B-1 through B-48 are assumed to apply to all aircraft, whether fixed-wing or helicopter[1]. These values are considered appropriate for supersonic jet aircraft when operating at subsonic speeds.

i. <u>Potential icing</u> is defined as the presence of clouds at temperatures of -3°C or colder but no colder than -30°C.

j. <u>Probable icing</u> is defined as icing that <u>should</u> occur (or the chance that icing will occur) at flight level with a known value of potential icing at that level. Probable icing is determined through the application of empirical aircraft-icing data to potential-icing values. The occurrence of probable icing will always be less than that for potential icing under the same cloud and temperature conditions.

k. Unless otherwise noted, all heights are given in feet above mean sea level (MSL). Since mean sea level is used as the reference for all altitudes in the atmosphere, the station elevation should be subtracted from the height given for icing in feet above MSL in order to determine the height of icing above that station.

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[1] General criteria for all rotary-wing aircraft are not available since the conformation and aeronautical characteristics of these craft vary greatly with each make and model. However, icing data determined under this method have been furnished to and used for rotary-wing aircraft with no known adverse effect.

l. Each of the monthly Northern Hemisphere icing charts "Probability of Encountering Icing Conditions" (Figures B-1 through B-48) is presented as one of four pressure surfaces (1000, 850, 700, and 500 mb). Table A-2 in Appendix A gives the conversion of the pressure surfaces to the mean height in feet above MSL depending upon the latitude and month required.

Procedure

The procedure used in determining the probability of aircraft-icing values as indicated above a particular station on the charts, described in subparagraph *l* above, requires the use of Figure A-1 and Table A-1, included in Appendix A of this report, and radiosonde temperature/dew-point data. This step-by-step procedure is outlined below:

a. Using a station's radiosonde observation, enter the air temperature and the temperature/dew-point spread at the desired pressure surface on the diagram in Figure A-1, Appendix A. As previously mentioned, this study considered pressure at 1000, 850, 700, and 500 mb; but the procedure need not be confined to these particular surfaces.

b. If the values lie under the 95% curve in Figure A-1, the observation is considered a "yes" (Y) for potential icing. If the values lie above the 95% curve, a "no icing" tag is assigned. All available radiosonde observations for a specific station are similarly considered regardless of whether they are taken at 00Z or 12Z.

c. Each "yes" observation is assigned a percent frequency of icing (F) from Table A-1. The percent frequencies are summed by pressure surface and month. The "yes" observations are also similarly summed.

d. Divide the number of "yes" observations (organized by month and pressure surface) by the total number of valid observations for the particular month and pressure surface, i.e., observations with no missing temperature or dew points.

e. For the desired month and pressure surface divide the total of the percent frequencies of icing by the number of "yes" observations for that month and surface, and by 100.

f. Multiply the result of d by the result of e. This will represent the probability of icing above the station at the prescribed surface and for the month of interest. Figures B-1 through B-48 are analyzed for specific icing probabilities as derived for individual stations.

g. The end product of this computation is the determination of specific icing probabilities for individual stations. Figures B-1 through B-48 are the isoline analyses of these calculations.

Represented in mathematical terms, the procedure would be:

$$(1)\qquad \overbrace{\left(\frac{\sum_{i=1}^{n} Y}{n}\right)}^{\text{Potential Icing Term}} \overbrace{\left(\frac{\sum_{i=1}^{n} F}{100 \sum_{i=1}^{n} Y}\right)}^{\text{Probable Icing Term}} = P(I)$$

where: Y = a "yes" observation

n = total number of observations considered

F = percent frequency of icing

P(I) = probability of icing

For an example of this procedure, see Appendix A of this report. This procedure has been committed to a computer program that processes radiosonde data tapes for an individual station and prints out the monthly percentage frequencies of icing for every 50 mb, where available. Additional information, such as potential icing and an observation count for each pressure surface, is also part of the output. Table 1 is an abbreviated example of a station printout.

TABLE 1

Sample Computer Output for January and February — Percentage Frequency of Occurrence of Icing.

OMAHA, NEBRASKA — EL 982'

JAN	PROB*	POT**	NUM OBS***	FEB	PROB*	POT**	NUM OBS***
1000mb	0.00	0.00	0	1000mb	0.00	0.00	0
950mb	6.00	22.44	673	950mb	3.93	12.54	514
900mb	5.69	20.94	683	900mb	6.03	18.42	619
850mb	5.00	16.84	683	850mb	4.70	15.05	618
800mb	4.31	14.66	682	800mb	5.48	15.99	619
750mb	3.99	13.93	682	750mb	5.37	16.16	619
700mb	4.01	15.10	682	700mb	5.15	17.45	619
650mb	3.40	16.01	681	650mb	4.30	17.77	619
600mb	3.04	17.16	682	600mb	3.51	19.39	619
550mb	2.63	18.30	683	550mb	2.78	18.93	618
500mb	2.35	18.44	678	500mb	2.18	17.96	618
450mb	1.34	12.12	660	450mb	1.14	10.70	598

* Probability of icing in %.
** Potential icing in %.
*** Number of radiosonde observations at the indicated pressure surface.

Analysis — Probability of Encountering Icing Conditions

Over 380 radiosonde station computer tapes, containing at least five years of station data each, were processed and the results plotted. A station listing and locator chart are included in Appendix B. Figures B-1 through B-48 are monthly Northern Hemisphere charts that have been analyzed for every .050 interval of probability of icing for each of the four pressure surfaces previously noted.

Areas are shaded for surface topography above the pressure surface of the particular chart. Since the pressure surface intersects the ground surface around the boundary of these shaded areas, it is impossible to analyze for the pressure surfaces falling within these boundaries. For example, Lander, Wyoming is at 5558' above MSL and at 42°42'N. According to Table A-2, Appendix A, the 850-mb pressure surface at 45°N averages 4800' above MSL. This means that the 850-mb pressure surface lies an average of 700' to 800' below the Lander topography. There will, therefore, be no 1000-mb or 850-mb analysis for icing over Lander. Also from Table A-2, the height of the 700-mb surface averages 10,000' at 45°N. This means that Lander data will appear on the 700-mb and also on the 500-mb analyses.

Verification of Results

The potential icing term in Equation (1) was verified in two ways. One method of verification was a rough match of "yes" forecasts from Figure A-1, Appendix A, to the existence of actual cloud cover. The second method utilized the Chi-square statistical method to show that the potential-icing values that were forecast and accumulated were not likely by chance.

It was felt that in Equation (1) the probable aircraft-icing term could have been verified only by an extensive series of flights similar to the reconnaissance flights of 1952 through 1955. The "F" term (percentage frequency of icing from Table A-1, Appendix A) is based on these flights. Because of the cost and time involved, no attempt was made to verify these values found in Table A-1.

a. The Existence of Clouds vs Occurrence of Potential Icing. Actual cloud observations are not considered in this study since it was felt that the entry of values into Figure A-1, Appendix A, provided adequate estimates of 5/10 or greater cloud cover. In order to determine whether this assumption was reasonable, the "yes" values for icing were compared date-for-date with cloud cover over five selected stations. If the cloud cover was ≥ 5/10 (regardless of cloud height), the occurrence remained a "yes" for icing; if the cloud cover was < 5/10, the value was considered a "No." Table 2 illustrates the results, where:

X = number of predicted potential-icing occurrences.

Y = number of icing occurrences predicted, but where there was < 5/10 cloud cover.

X-Y = number of icing occurrences predicted after occurrences of < 5/10 cloud cover have been subtracted.

$Z = \frac{(X-Y)}{X} \times 100$ = Percentage ratio of successfully predicted potential icing.

Except for the 950- and 850-mb surfaces at Fairbanks, Alaska, the existence of ≥ 5/10 cloud cover verified the potential-icing forecasts in at least 80% of the cases.

TABLE 2

ETAC Method vs Occurrence of < 5/10 Cloud Cover When Icing Was Predicted.

	No. of Occurrences			$\frac{X-Y}{X} \times 100$
	X	Y	X-Y	(in %)
Edwards AFB, CA, POR: 1951-67, Elev. 2312 ft				
850 mb	3	0	3	100.0
700 mb	70	10	60	85.7
500 mb	177	26	151	85.3
Hill AFB, UT, POR: 1950-63, Elev. 4788 ft				
850 mb	33	6	27	81.8
700 mb	811	101	710	87.5
500 mb	1957	195	1762	90.0
McChord AFB, WA, POR: 1956-62, Elev. 322 ft				
850 mb	171	10	161	94.2
700 mb	824	54	770	93.4
500 mb	1033	58	975	94.4
Great Falls, MT, POR: 1948-63, Elev. 3657 ft				
850 mb	376	50	326	86.7
700 mb	1038	147	891	85.8
500 mb	1918	215	1703	88.8
Fairbanks, AK, POR: 1957-67, Elev. 547 ft				
950 mb	459	186	273	59.5
850 mb	854	231	623	73.0
700 mb	1536	262	1274	82.9
500 mb	1158	106	1052	90.8

b. Application of the Chi-square Statistical Method. During 1968-1969, 6WWg OL-A at Wright-Patterson AFB, OH requested special local flights of a T-33 aircraft [5]. A total of 49 flights were conducted to sample the liquid-water content of clouds, flight-level temperatures, and icing type and intensity, if any, found in the clouds. This was done for flight levels ranging from 2500 to 24,000 feet during the winter and early spring months. Data from these flights are unpublished.

Icing data from these flights were compared date-for-date with forecasts of potential icing that were made using Figure A-1, Appendix A, and Dayton, OH radiosonde data. The flight data indicated that 80% of the forecasts made from

the radiosonde data correctly said "Yes" or "No." A 2×2 matrix was developed using the following format:

(2)

		B_j		
		B_1	B_2	
A_i	A_1	A_1B_1	A_1B_2	Total A_1
	A_2	A_2B_1	A_2B_2	Total A_2
		Total B_1	Total B_2	

Where A_i is the icing observed by the aircraft and B_j is the icing forecast using the Dayton radiosonde data and applying the potential icing term of Equation (1).

(3)

		Icing Forecast		
		Yes	No	Totals
Icing Observed	Yes	25	2	27
	No	9	19	28
	Totals	34	21	

(4) $$X^2 = \Sigma_i \Sigma_j \left[\frac{d_{ij}^2}{(A_iB_j)_o}\right]$$

where

(5) $$d_{ij} = (A_iB_j) - (A_iB_j)_o$$

(6) $$(A_iB_j)_o = \frac{(A_i)\ (B_j)}{N}$$

The 2×2 matrix has one degree of freedom derived as follows:

(rows - 1) × (columns - 1)

(7) $$(2-1) \times (2-1) = 1$$

This greatly simplifies our use of Chi-square.

From Chi-square statistical tables we assume the 95th percentile or $X^2_{.95}$ = 3.84 and the 99.5th percentile or $X^2_{.995}$ = 7.38.

An analysis of the 2×2 matrix (Equation 3) reveals the following values for each:

$$\frac{d^2_{ij}}{(A_iB_j)_o}:$$

$$\frac{d^2_{1,1}}{(A_1B_1)_o} = \frac{68.89}{16.7} = 4.125$$

$$\frac{d^2_{1,2}}{(A_1B_2)_o} = \frac{68.89}{10.3} = 6.688$$

$$\frac{d^2_{2,1}}{(A_2B_1)_o} = \frac{68.89}{17.3} = 3.982$$

$$\frac{d^2_{2,2}}{(A_2B_2)_o} = \frac{68.89}{10.7} = 6.438$$

This gives us the following matrix:

	B_1	B_2	
A_1	4.125	3.982	8.107
A_2	6.688	6.438	13.126
	10.813	10.420	$21.233 = \Sigma_i\Sigma_j \left[\frac{d^2_{ij}}{(A_iB_j)_o}\right]$

Then $X^2 = 21.233$

Since X^2 is considerably larger than $X^2_{.95}$ and $X^2_{.995}$, the forecast occurrence of icing is significantly dependent upon the forecast method and the results are not likely by chance. Thus, the potential-icing term for use in determining aircraft icing appears to be valid.

Summary

Certain definitions and assumptions were formulated stipulating criteria for aircraft icing. Then, using radiosonde and empirical aircraft-icing data, it was illustrated that a step-by-step procedure can be developed to determine the probability of occurrence of aircraft icing. The equation that was derived for this procedure has a probable icing and a potential icing term. Combining both the potential- and probable-icing terms gives the probability of encountering icing conditions over a station. Accumulated climatological data from the combined terms have been analyzed for the Northern Hemisphere on monthly charts for the 1000-, 850-, 700-, and 500-mb surfaces. These charts should provide a valuable tool for aircraft design and mission planning.

The development of probable-icing values above a station need not be confined to the surfaces of the monthly charts. Other pressure surfaces can be used provided the temperature and dew point are available.

The potential-icing term was verified, first through a test for the presence of clouds and then through use of Chi-square statistical methods applied to actual test flights.

REFERENCES

[1] AWSM 105-39: "Forecasters' Guide on Aircraft Icing," Hq Air Weather Service, 53 p., 7 January 1969.

[2] Bowden, D. T., Gensemer, A. E., and Skeen, C. A.: "Engineering Summary of Airframe Icing Technical Data," Technical Report ADS-4, Federal Aviation Agency, 80 p., March 1964.

[3] Katz, Lawrence G.: "Climatological Probability of Aircraft Icing," AWSTR 194, Hq Air Weather Service (ETAC), 24 p., January 1967.

[4] Perkins, P., Lewis, W., and Mulholland, D.: "Statistical Study of Aircraft Icing Probabilities at the 700- and 500-Millibar Levels Over Ocean Areas in the Northern Hemisphere," Technical Note 3984, National Advisory Committee for Aeronautics, 31 p., May 1957.

[5] 6WWg OL-A: "Transmittal of Liquid Water Content (LWC) Test Data," ltr w/Atch (unpublished data).

Appendix A

AN EXAMPLE OF THE DETERMINATION OF PROBABILITY OF AIRCRAFT ICING

Sample Procedure for Determining Probability of Aircraft Icing

Given: 1200Z, 700-mb radiosonde data for Caribou, ME, 1-16 December 1963.

Date	T Temp (°C)	T_d Dew Pt	$T - T_d$	Y Appendix A Figure A-1	F Appendix A Table A-1
1	-16	-27.2	11.2	No	--
2	-26.9	*	*	No	--
3	-16.6	*	*	No	--
4	-12.2	-15.1	2.9	Yes	22.7%
5	-19.4	-26.6	7.2	No	--
6	-15.6	-25.1	9.5	No	--
7	-16.6	-21.3	4.7	No	--
8	-9.4	-14.0	4.6	No	--
9	-8.0	-15.7	7.7	No	--
10	-15.9	-20.4	4.5	No	--
11	-17.8	-20.4	2.6	Yes	17.4%
12	-18.1	*	*	No	--
13	-21.6	-26.6	5.0	No	--
14	-20.5	-23.7	3.2	Yes	17.4%
15	-18.9	-22.1	3.3	Yes	17.4%
16	-19.9	-23.0	3.1	Yes	17.4%
TOTALS				$\Sigma Y = 5$	$\Sigma F = 92.3$

* Indicates that radiosonde instrument was "motorboating" thus implying that the dew point was too low to give a reading.

We use Equation (1) from the text:

$$\left(\frac{\sum_{i=1}^{n} Y}{n}\right)\left(\frac{\sum_{i=1}^{n} F}{100\sum_{i=1}^{n} Y}\right) = P(I) \tag{1}$$

$n = 16$

$\Sigma Y = 5$ Then $P(I) = (5/16)\left(\frac{92.3}{100 \times 5}\right) = .058$

$\Sigma F = 92.3$

<u>Interpretation</u>: The probability of occurrence of icing over Caribou, ME, at 700 mb during 1-16 December 1963 was .058. The percentage frequency of occurrence was 5.8%. If five to ten Decembers of 700-mb data are handled in like manner, we are able to compile an aircraft icing climatology that can be interpreted as the probability of encountering icing conditions over Caribou, ME, during December. This is the type of data that is analyzed on Figures B-1 through B-48.

As an added bonus, we can find the <u>potential</u> icing over a station by using the potential-icing term or

$$\frac{\sum_{i=1}^{n} Y}{n}$$

For Caribou, during 1-16 December 1963, the potential icing was 5/16 or 31%. Potential-icing values have been found very useful for guiding the development of and planning missions for helicopter-type aircraft.

TABLE A-1

(From Attachment 1, AWSM 105-39)

Frequency of Aircraft Icing by Air Temperature and Dew-Point Spread
(from observations having a dew-point report made in stratiform clouds)

Air Temperature (°C)		No. of Obs.	No. of Icing Cases	% Freq of Icing
0 to -2	With spread = 0°	245	41	16.7
	With spread > 0°	49	8	16.3
	Total	294	49	16.7
-3 to -7	With spread ≤ 1°	1101	563	51.1
	With spread > 1°	114	37	32.5
	Total	1215	600	49.4
-8 to -12	With spread ≤ 2°	1018	418	41.1
	With spread > 2°	141	32	22.7
	Total	1159	450	38.8
-13 to -17	With spread ≤ 3°	1251	237	18.9
	With spread > 3°	133	15	11.3
	Total	1384	252	18.2
-18 to -22	With spread ≤ 4°	772	134	17.4
	With spread > 4°	77	7	9.1
	Total	849	141	16.6
-23 to -27	With spread ≤ 5°	347	38	11.0
	With spread > 5°	35	5	14.3
	Total	382	43	11.3
-28 to -32	With spread ≤ 6°	160	15	9.4
	With spread > 6°	20	0	0.0
	Total	180	15	8.3
Grand Total		5463	1550	28.4

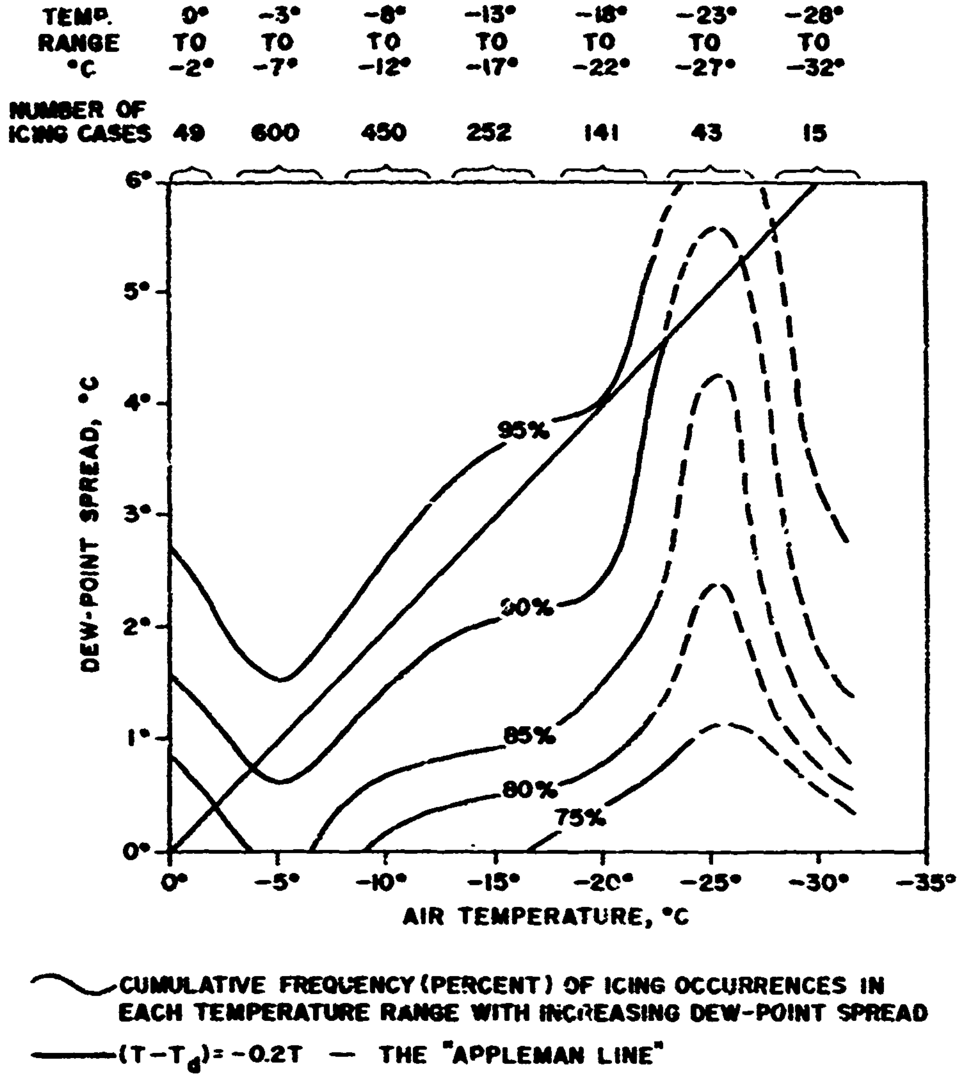


Figure A-1. Graph of Cumulative Frequencies of Icing Occurrences as Functions of Temperature and Dew-Point Spread (from Attachment 1, AWSM 105-39).

TABLE A-2

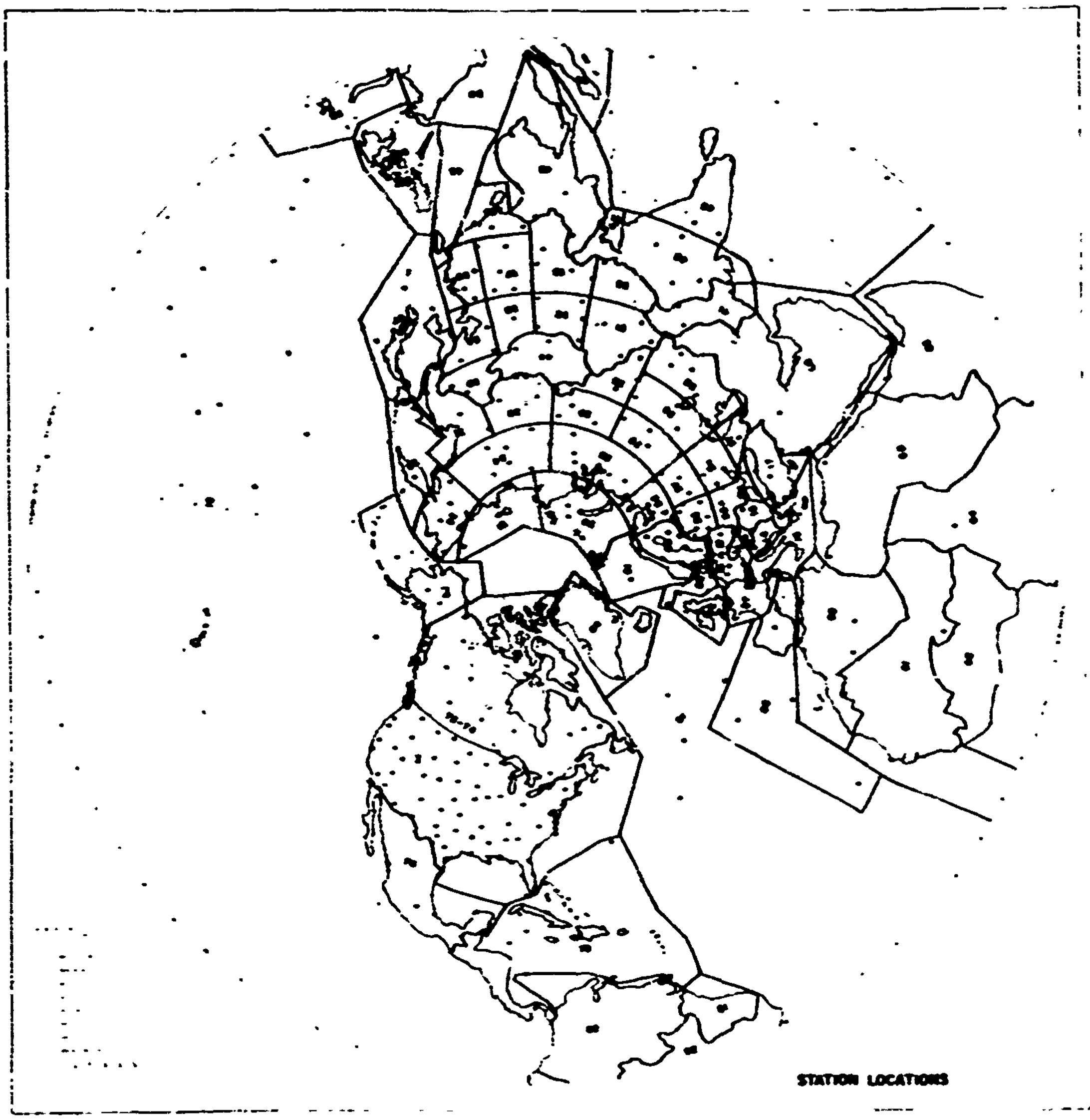
Mean Heights of Selected Pressure Surfaces at Sample Locations
(ft above MSL)

	1000 mb						700 mb				
	> 75°N Mould Bay NWT	60°N Anchorage, AK	45°N Glasgow, MT	30°N Eglin AFB, FL	< 20°N Balboa CZ		> 75°N Mould Bay NWT	60°N Anchorage, AK	45°N Glasgow, MT	30°N Eglin AFB, FL	< 20°N Balboa CZ
Jan	469	240	591	568	305	Jan	8973	9268	9646	10,180	10,299
Feb	417	180	554	515	305	Feb	8861	9206	9596	10,154	10,293
Mar	548	210	482	479	302	Mar	9081	9255	9695	10,161	10,306
Apr	535	213	423	469	295	Apr	9278	9373	9823	10,253	10,319
May	541	299	335	456	285	May	9438	9619	10,003	10,341	10,322
Jun	456	338	272	446	292	Jun	9675	9829	10,092	10,420	10,322
Jul	328	394	315	492	285	Jul	9678	9961	10,289	10,499	10,319
Aug	348	325	289	456	289	Aug	9652	9885	10,240	10,479	10,316
Sep	390	226	358	443	285	Sep	9465	9652	10,102	10,413	10,309
Oct	325	62	413	482	285	Oct	9134	9301	9961	10,322	10,296
Nov	397	72	505	548	282	Nov	9006	9193	9744	10,272	10,236
Dec	371	62	535	577	285	Dec	8901	9072	9734	10,220	10,289
Ann	427	217	427	495	29[illegible]	Ann	9266	9465	9908	10,312	10,306

	850 mb						500 mb				
Jan	4337	4393	4715	4987	4936	Jan	16,735	17,346	17,841	18,819	19,208
Feb	4252	4341	4675	4957	4930	Feb	16,548	17,257	17,766	18,783	19,201
Mar	4432	4393	4721	4948	4933	Mar	16,837	17,297	17,913	18,809	19,224
Apr	4521	4465	4780	4993	4940	Apr	17,182	17,474	18,143	18,957	19,240
May	4639	4629	4823	5039	4936	May	17,559	17,861	18,524	19,111	19,240
Jun	4692	4741	4833	5075	4936	Jun	17,949	18,238	18,740	19,262	19,234
Jul	4636	4829	4948	5141	4933	Jul	18,048	18,461	19,022	19,364	19,221
Aug	4626	4760	4908	5112	4933	Aug	17,995	18,383	18,973	19,364	19,214
Sep	4560	4600	4875	5069	4930	Sep	17,608	18,015	18,717	19,275	19,204
Oct	4363	4341	4816	5033	4923	Oct	17,077	17,487	18,471	19,104	19,195
Nov	4327	4281	4751	5026	4917	Nov	16,808	17,306	18,035	18,996	19,185
Dec	4255	4213	4738	5016	4923	Dec	16,660	17,103	18,028	18,878	19,201
Ann	4470	4495	4797	5033	4930	Ann	17,251	17,680	18,340	19,062	19,214

Appendix B

CHARTS OF ICING PROBABILITY



Station Locator Chart

STATION LOCATOR LIST

WMO	WBAN	NAME	LATITUDE	LONGITUDE	ELEVATION
01001		JANMAYENIS	N7101	E00828	128
01030		TROMSO NORWAY	N6942	E01901	79
01384		GARDERMOEN NORWAY	N6012	E01105	669
01415		SOLA NORWAY	N5853	E00538	43
02062		FROSON/OSTERSUND SWEDEN	N6311	E01437	1014
02077		STOCKHOLM SWEDEN	N5921	E01757	48
02084		GOTEBURG SWEDEN	N5743	E01147	23
02935		JYVASKLA FINLAND	N6224	E02540	459
02963		JOKIOINEN FINLAND	N6049	E02329	338
04018	16201	KEFLAVIK ICELAND	N6358	W02236	164
04202	17602	THULE AB GREENLAND	N7633	W06849	251
04280	16405	NARSARSSUAK GREENLAND	N6111	W04525	136
06011		THORSHAVN FAROE ISLAND	N6203	E00645	79
06180		COPENHAGEN DENMARK	N5538	E01240	16
06447		UCCLE BELGIUM	N5048	E00421	341
07170	34052	CHAUMONT FRANCE	N4806	E00503	1028
08159	14010	ZARAGOSA SPAIN	N4141	E00104	846
08221		BARAJAS/MADRID SPAIN	N4028	W00334	1988
08521		FUNCHAL MADIERA IS	N3238	W01654	190
08536		LISBOA PORTUGAL	N3846	W00908	347
08594		SAL CAPE VERDE IS	N1644	W02257	180
10184		GREIFSWALD E GERMANY	N5406	E01323	16
10393		LINDENBERG E GERMANY	N5213	E01407	328
10486		DRESDEN E GERMANY	N5107	E01341	758
10633	35010	WIESBADEN W GERMANY	N5005	E00815	482
10866	34174	MUNICH W GERMANY	N4809	E01135	1670
11035		VIENNA AUSTRIA	N4815	E01622	696
11934		POPRAD CZECH	N4904	E02015	2320
12374		LEGIONOWO POLAND	N5225	E02058	340
12425		WROCLAW I POLAND	N5108	E01659	407
12843		BUDAPEST HUNGARY	N4726	E01911	473
13130		MAKSIMAR/ZAGREB YUGOSLAVIA	N4548	E01600	400
13276		BEOGRAD YUGOSLAVIA	N4447	E02032	797
16716		ATHENS GREECE	N3754	E02344	33
16754	33208	IRAKLION CRETE	N3519	E02515	43
17030		SAMSUN TURKEY	N4117	E03620	144
17130		ANKARA TURKEY	N3957	E03253	2933
17220		IZMIR TURKEY	N3826	E02710	82
17606		NICOSIA CYPRUS	N3509	E03317	734
20046		DRUZHNYY OSTROV	N8037	E05757	66
20069		OSTROV VIZE USSR	N7930	E07659	59
20107		BARENTSBURG USSR	N7804	E01413	66
20274		OSTRO VEDINENIYA USSR	N7730	E08214	30
20292		CHELYUSKIN MYS SIBERIA	N7743	E10417	43
20353		MYS ZHELANIYA USSR	N7657	E06835	26
20667		BELYY OSTROV USSR	N7320	E07002	20

STATION LOCATOR LIST

WMO	WBAN	NAME	LATITUDE	LONGITUDE	ELEVATION
21504		OSTROV PREOBRAZHENIYA SIBE	N7440	E11256	20
21647		MYS SHALAUROVA SCA	N7311	E14356	33
21824		BUKHTA TIKSI SIBERIA	N7135	E12855	26
21965		CHETYREKHSTOLBOVOY OSTROV	N7038	E26224	20
21982		WRANGEL OSTROV SIBERIA	N7058	E17832	10
22113		MURMANSK USSR	N6858	E03303	151
22165		KANIN NOS USSR	N6839	E04318	157
22522		KEM USSR	N6457	E03439	30
22550		ARKHANGEL'SK USSR	N6434	E04032	43
22802		SORTAVALA USSR	N6143	E03043	59
23022		AMDERMA SIBERIA	N6945	E06139	48
23074		DUDINKA SIBERIA	N6924	E08610	94
23146		KAMENNYY MYS SIBERIA	N6828	E07336	SL
23205		NARYAN-MAR USSR	N6739	E05301	23
23274		IGARKA SIBERIA	N6728	E08634	98
23330		OBDORSK/SALEKHARD SIB	N6632	E06632	115
23418		PECHORA SIBERIA	N6508	E05714	UNK
23472		MONASTYRSKOYE/TURUKHANSK	N6547	E08757	105
23804		SYKTYVKAR SIBERIA	N6140	E05051	UNK
23884		PODKAMENNAYA TUNGUSKA SIB	N6136	E09000	197
24125		OLENEK SIB	N6830	E11226	417
24266		VERKHOYANSK SIB	N6733	E13323	449
24343		ZHIGANSK SIB	N6646	E12324	190
24507		TURA SIB	N6417	E10015	459
24641		VILJUJSK SIBERIA	N6346	E12137	351
24759		YAKTUSK OBSV SIBERIA	N6201	E12943	338
24817		ERBOGACHEN/YERBOGACHEN SIB	N6116	E10801	912
24959		JAKUTSK/YAKUTSK SIBERIA	N6205	E12945	338
25173		MYS SHMIDTA SIBERIA	N6855	E17929	23
25399		MYS UELEN SIBERIA	N6610	E16950	23
25428		ULYGA /ULIAGAI SIBERIA	N6505	E16037	UNK
25551		MARKOVO SIBERIA	N6441	E17025	108
25594		BUKHTA PROVIDENIA SIB	N6426	E17314	10
25677		BUKHTA UGOLNAYA SIBERIA	N6303	E17919	3
25703		SEYMCHAN SIBERIA	N6255	E15225	679
25913		NAGAYEVO SIBERIA	N5935	E15047	387
25954		KORF SIB	N6021	E16600	UNK
26038		TALLIN USSR	N5925	E02448	144
26063		LENINGRAD USSR	N5958	E03018	13
26298		BELOGOYE USSR	N5754	E03403	584
26422		RIGA LATVIA USSR	N5658	E02204	10
26629		KAUNAS LITHUANIA USSR	N5453	E02353	246
26781		SMOLENSK USSR	N5445	E03204	791
26850		MINSK USSR	N5352	E02732	692
27196		KIROV USSR	N5836	E04937	607
27553		STRINGINO USSR	N5613	E04349	269

STATION LOCATOR LIST

WMO	WBAN	NAME	LATITUDE	LONGITUDE	ELEVATION
27612		MOSCOW USSR	N5545	E03734	512
28440		SVERKLOVSK SIBERIA	N5648	E06038	788
28698		OMSK SIBERIA	N5456	E07324	308
28900		KUIBYSHEV USSR	N5315	E05027	144
28952		KUSTANAY SIBERIA	N5313	E06337	561
29231		KILPASHEVO SIBERIA	N5818	E08254	249
29282		BOGUCHANY SIBERIA	N5825	E09724	440
29574		KRASNOYARSK SIBERIA	N5600	E09253	UNK
30521		ZHIGALOVO SIB	N5448	E10510	1362
30673		MOGOCHA SIB	N5344	E11947	2031
30935		KRASNYY CHIKOY SIB	N5022	E10845	2526
30965		BORZYA SIB	N5023	E11831	2244
31004		ALDAN SIBERIA	N5837	E12522	2238
31088		OKHOTSK SIBERIA	N5922	E14312	20
31329		EKIMCHAN SIBERIA	N5304	E13256	1782
31369		NIKOLAYEVSK-NA-AMURE SIB	N5309	E14042	UNK
31510		BLAGOVESHCHENSK SIBERIA	N5016	E12730	449
31707		EKATER NIKOLSKOE/YEKAT NIK	N4744	E13058	243
31909		TERNEY SIB	N4502	E13640	36
31960		VLADIVOSTOK SIB	N4307	E13145	453
32099		MYSPOVORCTNYY/TIRUE SAKH	N4853	E14438	UNK
32165		YUZHNO-KURILISK KURIL IS	N4401	E14549	131
32217		MYS VASILEVA KURIL IS	N5000	E15523	53
32389		KLYUCHI SIB	N5619	E16050	82
33345		KIEV USSR	N5024	E03027	587
33658		CHERNOVTSY USSR	N4816	E02558	787
33837		ODESSA USSR	N4629	E03044	214
34139		KAMENNAYA USSR	N5103	E04042	636
34300		KHAR'KOV USSR	N4958	E03615	499
34731		ROSTOV-NA-DONU USSR	N4715	E03949	157
34880		ASTRAKHAN USSR	N4621	E04803	-82
35229		AKTUYBINSK USSR	N5017	E05709	745
35394		KARAGANDA SCA	N4948	E07338	1821
37985		LENKORAN USSR	N3844	E04850	-36
38392		TASHAUZ SCA	N4150	E05959	UNK
38457		TASHKENT SCA	N4116	E06916	1404
38687		CHARDZHOU SCA	N3905	E06336	633
38750		GASAN-KULI SCA	N3728	E05358	-75
38836		STALINABAD SCA	N3835	E06847	2703
38989		TAKHTA-BAZAR USSR	N3558	E06255	UNK
40007		ALEPO SYRIA	N3611	E03713	1276
40100		BEIRUT/BEYROUTH LEBANON	N3349	E03529	79
40181		BEER-YA AODV ISRAEL	N3156	E03450	207
40427		BAHRAIN/MUHARRAG ARABIA	N2616	E05037	6
40597		ADEN/KHORMAKSAR ARABIA	N1250	E04502	10
40648		HABBANIYA IRAQ	N3322	E04334	147

STATION LOCATOR LIST

WMO	WBAN	NAME	LATITUDE	LONGITUDE	ELEVATION
41530		PESHAWAR PAKISTAN	N3401	E07133	1177
41640		LAHORE PAKISTAN	N3135	E07418	762
41780		KARACH PAKISTAN	N2455	E06709	73
41917		DACCA PAKISTAN	N2346	E09023	255
42182		DELHI/NEW DELHI INDIA	N2853	E07712	710
42339		JODHPUR INDIA	N2618	E07301	736
42410		GAUHATI INDIA	N2605	E09143	178
42475		ALLAHABAD INDIA	N3[illegible]23	E07642	892
42809		CALCUTTA INDIA	N2239	E08827	33
42867		NAGPUR INDIA	N2106	E07903	1018
42909		VERAVAL INDIA	N2054	E07022	26
43063		POONA INDIA	N1832	E07351	1835
43149		VISAKHAPATNAM INDIA	N1742	E08318	11
43279		MADRA/MINAMBAKKAM INDIA	N1300	E08011	51
43333		PORT BLAIR ANDAMAN	N1140	E09243	259
43371		TRIVANDRUM INDIA	N0829	E07655	211
43466		COLOMBO CEYLON	N0656	E07951	20
44354		SAINSHAND/SAYN SHANDA	N4454	E11007	3071
45005		HONG KONG	N2218	E11410	109
46697		TAOYUAN TAIWAN	N2505	E12123	165
47122	43242	OSAN-NI S KOREA	N3706	E12702	48
47187	43263	MOSULPO S KOREA	N3312	E12313	43
47401		WAKKANAI JAPAN	N4525	E14141	24
47412		SAPPORO JAPAN	N4303	E14120	59
47582		AKITA JAPAN	N3943	E14006	49
47600		WAJIMA JAPAN	N3723	E13654	22
47646		TATENO JAPAN	N3603	E14008	89
47678		HACHIJOJIMA JAPAN	N3306	E13947	299
47744		MIHO AB JAPAN	N3526	E13321	15
47778		SHIONOMISAKI JAPAN	N3327	E13546	246
47807		FUKUOKA JAPAN	N3335	E13023	22
47909		NAZE JAPAN	N2823	E12930	14
47931	42234	KADENA AB RYUKYU IS	N2621	E12745	142
47981	42401	IWO JIMA VOLCANO IS	N2447	E14119	353
48327		CHAING MAI THAILAND	N1847	E09859	1100
48455		BANGKOK THAILAND	N1344	E10030	39
48568		SINGORA/SONGKHLA THAILAND	N0711	E10037	13
48900		SAIGON RVN	N1049	E10640	33
51431		INING CHINA	N4355	E08117	2198
51709		KASHGAR/SU-LO CHINA	N3924	E07603	UNK
51777		CHARKHLIK/NOCHIANG CHINA	N3905	E08803	3117
51828		HOTIEN/KHOTAN CHINA	N3707	E07955	4558
52203		HAMI CHINA	N4250	E09327	2411
52267		SOH-KUO-NOR CHINA	N4215	E10113	2884
52533		CHIA-YU-KUAN/CHIUCHUAN	N3950	E09815	5061
52818		KARMU CHINA	N3612	E09438	9350

STATION LOCATOR LIST

WMO	WBAN	NAME	LATITUDE	LONGITUDE	ELEVATION
52889		KAOLAN/LANCHOW CHINA	N3603	E10347	4987
53546		CHASAKOCHI CHINA	N3917	E10945	UNK
54102		PANTEGAGA SUME CHINA	N4351	E11605	3169
54161		CHANGCHUN CHINA	N4352	E12520	709
54511		PEI-CHING/PEIPING CHINA	N3956	E11620	168
54662		CHOU-SHUI-TZ/TALIEN CHINA	N3854	E12138	312
54857		CHING-TAO CHINA	N3604	E12019	256
55299		ADAG MAMAR CHINA	N3206	E09216	13123
55591		LASA/LHASA CHINA	N2943	E09102	12001
56137		CHANGTU CHINA	N3110	E09716	10499
56294		CHENG TU CHINA	N3041	E10404	1634
56571		HSI CHANG CHINA	N2753	E10218	5246
56739		TENG CHUNG CHINA	N2507	E09829	5338
56989		HO KOU CHINA	N2227	E10354	439
57036		HSI-KUAN/HSI-AN CHINA	N3415	E10855	1312
57083		CHENG-HSEIN/CHENGCHOW CHINA	N3443	E11343	UNK
57461		I CHANG CHINA	N3040	E11127	230
57745		CHIHCHIANG CHINA	N2727	E10938	879
57993		KANHSIEN CHINA	N2550	E11450	361
58027		HSU-CHOU/SUCHOW CHINA	N3415	E11715	148
58238		NAN-CHING/NANKING CHINA	N3205	E11845	236
58367		HUNG-CHA/SHANGHAI CHINA	N3112	E12126	15
58606		NANCHANG CHINA	N2840	E11558	161
58847		FOOCHOU/FU CHOU CHINA	N2605	E11918	289
59211		PAISE CHINA	N2355	E10632	650
59265		WUCHOU CHINA	N2330	E11125	391
59316		SWATOW CHINA	N2321	E11640	17
59559		HENG-CHUN/HENGCHUNG FORMOSA	N2200	E12045	72
59758		HAIKOU CHINA	N2000	E11025	46
59981		HSI SHA CHOW CHINA	N1651	E11220	7
60119	13017	PORT LYAUTEY MOROCCO	N3416	W00656	39
60390		ALGER/MAISON BLANCHE ALGERIA	N3643	E00315	82
60625		AOULEF ALGERIA	N2658	E00105	951
61052		NIAMEY NIGER	N1329	E00210	768
61401		FORT TRINQUET MAURITANIA	N2514	W01137	1181
61642		DAKAR/OUAKAM SENEGAL	N1440	W01726	128
62011	33123	WHEELUS AB/TRIPOLI LIBYA	N3254	E01317	82
62062		EL ADEM AF/TOBRUK LIBYA	N3205	E02359	47
62378		HELWAN UAR	N2952	E03120	463
62414		ASWAN UAR	N2405	E03253	636
62721		KHARTOUM SUDAN	N1536	E03233	1247
70026	27502	BARROW WBAS ALASKA	N7118	W15647	13
70086	27401	BARTER IS ALASKA	N7008	W14338	50
70133	26616	KOTZEBUE ALASKA	N6652	W16238	16
70200	26617	NOME ALASKA	N6430	W16526	22
70231	26510	MC GRATH WBAS ALASKA	N6258	W15537	337

STATION LOCATOR LIST

WMO	WBAN	NAME	LATITUDE	LONGITUDE	ELEVATION
70261	26411	FAIRBANKS ALASKA	N6449	W1475	411
70273	26409	ANCHORAGE ALASKA	N6113	W14950	135
70308	25713	ST PAUL I ALASKA	N5709	W17013	22
70316	25624	COLD BAY ALASKA	N5512	W16243	103
70350	25501	KODIAK ALASKA	N5744	W15231	112
70361	25339	YUKUTAT ALASKA	N5931	W13940	36
70398	25308	ANNETTE IS WBAS ALASKA	N5502	W13134	119
70414	45708	SHEMYA IS ALASKA	N5243	W17406	95
70454	25704	ADAK ALASKA	N5153	W17638	18
72	23201	CHICO AAFCALIF	N3947	W12151	237
72	24240	TATOOSH IS WASH	N4823	W12444	119
72	24244	SEATTLE FWC WASH	N4741	W12216	37
72	26317	AKLAVIK NWT CANADA	N6814	W13500	30
72	93722	SILVER HILL OBS MD	N3850	W07657	291
72201	12850	KEY WEST FLA	N2435	W08147	22
72202	12839	MIAMA WBAS FLA	N2549	W08017	24
72206	13889	JACKSONVILLE FLA	N3025	W08139	39
72208	13880	CHARLESTON WBAS S C	N3254	W08002	46
72211	12842	TAMPA WBAS FLA	N2758	W08232	36
72221	13858	EGLIN AFB FLA	N3029	W08631	66
72224	12879	CAPE SAN BLAS FLA	N2941	W08521	10
72226	13895	MONTGOMERY WBAS ALABAMA	N3218	W08624	211
72235	13956	JACKSON MISSI	N3220	W09013	332
72240	03937	LAKE CHARLES LA	N3007	W09313	14
72248	13957	SHREVEPORT WBAS LA	N3228	W09349	251
72250	12919	BROWNSVILLE USWB TEXAS	N2600	W09726	17
72251	12926	CORPUS CRISTI NAS TEXAS	N2742	W09716	19
72253	12921	SAN ANTONIO TX	N2932	W09828	794
72259	13911	CARSWELL AFB TEXAS	N3246	W09725	650
72261	22001	LAUGHLIN AFB TEXAS	N2922	W10047	1081
72263	23017	GOODFELLOW AFB TEXAS	N3124	W10024	1878
72265	23023	MIDLAND TX	N3156	W10212	2858
72270	23044	EL PASO WBAS TEXAS	N3148	W10624	3956
72273	03124	FT HUACHUCA SIG CORPS AEPG	N3134	W11020	4674
72274	23160	TUCSON ARIZ	N3207	W11056	2558
72280	03125	TEST STA YUMA WBAS	N3251	W11424	334
72281	03146	EL CENTRO CA	N3249	W11540	58
72290	03131	SAN DIEGO CA	N3249	W11708	408
72304	93729	CAPE HATTERAS NC	N3516	W07533	11
72308	13737	NORFOLK WBAS VA	N3653	W07612	15
72311	13873	ATHENS ATLANTA GEORGIA	N3357	E08319	801
72317	13723	GREENSBORO WBAS N C	N3605	W07957	926
72327	13897	NASHVILLE WBAS TENN	N3607	W08641	601
72340	13963	LITTLE ROCK FAA/WBAS ARK	N3455	W09209	311
72353	13919	TINKER AFB OKLA CITY	N3525	W09724	1260
72363	23047	AMARILLO TX	N3514	W10142	3604

STATION LOCATOR LIST

WMO	WBAN	NAME	LATITUDE	LONGITUDE	ELEVATION
72365	23050	KIRTLAND WBAS N MEXICO	N3503	W10636	5352
72381	23114	EDWARDS AFB CALIF	N3455	W11754	2302
72386	23169	LAS VEGAS NEV	N3605	W11510	2171
72409	14780	LAKEHURST NAS N J	N4002	W07421	103
72429	13840	DAYTON OHIO	N3952	W08407	974
72445	13983	COLUMBIA WBAS MISSOURI	N3858	W09222	778
72451	13985	DODGE CITY WBAS KANSAS	N3746	W09958	2594
72456	13996	TOPEKA KANSAS	N3909	W09537	885
72469	23062	DENVER WBAS COLORADO	N3946	W10453	5332
72476	23066	GRAND JUNCTION WBO/WBAS	N3907	W10832	4839
72486	23154	ELY WBAS NEVADA	N3917	W1145	6262
72493	23230	OAKLAND WBAS CALIF	N3744	W12212	18
72506	14756	NANTUCKET WBAS MASS	N4115	W07004	47
72518	14735	ALBANY WBAS NEW YORK	N4245	W07348	277
72528	14733	BUFFALO WBAS NEW YORK	N4256	W07843	705
72532	14842	PEORIA WBAS ILL	N4040	W08941	622
72562	24023	NORTH PLATTE WBAS NEB	N4108	W10042	2787
72572	24127	SALT LAKE CITY WBAS UTAH	N4047	W11158	4226
72583	24128	WINNEMUCCA WBAS NEVADA	N4054	W11746	4339
72606	14764	PORTLAND MA	N4339	W07019	63
72645	14898	GREENBAY WBAS WIS	N4429	W08808	255
72575	24101	HILL AFB UTAH	N4107	W11158	4788
72576	24021	LANDER WYOMING	N4248	W10843	5558
72597	24225	MEDFORD WBAS OREGON	N4223	W12252	1329
72655	14926	ST CLOUD MINN	N4535	W09411	1043
72662	24090	RAPID CITY SD	N4403	W10304	3168
72681	24131	BOISE WBAS IDAHO	N4334	W11613	2858
72694	24232	SALEM WBAS OREGON	N4455	W12305	207
72712	14607	CARIBOU MAINE	N4653	W06758	58
72722	04734	MANIWAKI QUEBEC	N4622	W07559	559
72734	14847	SAULTE ST MARIE MICH	N4628	W08422	715
72747	14918	INTERNATIONAL FALLS MINN	N4836	W09324	1126
72764	24011	BISMARK N DAK	N4146	W10045	1677
72775	24143	GREAT FALLS MONT	N4729	W11122	3657
72768	24034	GLASGOW MONT	N4811	W10638	2109
72785	24157	SPOKANE WBAS WASH	N4737	W11731	2372
72807	14508	ARGENTIA CANADA	N4718	W05359	51
72811	15613	SEPT-ILES QUEBEC	N5 13	W06616	190
72815	14503	HARMON AFB NFLD	N4832	W05832	44
72816	15601	GOOSE DOT NFLD	N5318	W06027	156
72826	15703	NITCHEQUON QUEBEC	N5312	W07054	1759
72836	15803	MOOSONEE ONT DOT CANADA	N5116	W08039	34
72848	15806	TROUT LAKE ONT	N5350	W08115	720
72867	25034	THE PAS MAN USAAF CANADA	N5358	W10106	889
72906	15605	FORT CHIMO QUEBEC CANADA	N5806	W06826	122
72907	15704	PORT HARRISON QUE CANADA	N5827	W07808	66

STATION LOCATOR LIST

WMO	WBAN	NAME	LATITUDE	LONGITUDE	ELEVATION
72909	16603	FROBISHER BAY CANADA	N6345	W06833	110
72913	15901	CHURCHILL MANITOBA	N5845	W09404	94
72917	18801	EUREKA NWT DOT CANADA	N8013	W08611	8
72918	17802	ARCTIC BAY NWT	N7300	W08518	33
72924	17901	RESOLUTE NWT DOT CANADA	N7443	W09459	221
72926	16903	BAKER LAKE CANADA	N6418	W09600	50
72934	26102	FORT SMITH NWT DOT CANADA	N6000	W11152	665
72938	26107	COPPERMINE NWT APRT CANADA	N6749	W11505	28
72945	25218	FORT NELSON BC CANADA	N5850	W12235	1230
72964	26316	WHITEHORSE YT AAB CANADA	N6043	W13504	2305
74043	26202	NORMAN WELLS NWT	N6517	W12648	209
74072	27101	MOULD BAY NWT DOT CANADA	N7617	W11928	66
74081	16895	HALL BEACH NWT	N6847	W08115	20
74082	18601	ALERT NWT	N8233	W36246	207
74090	17601	CLYDE RIVER NWT CANADA	N7027	W 6833	1.
74123	25111	EDMONTON	N5334	W11331	2219
74486	94789	KENNEDY INT APT N Y	N4039	W07347	32
74794	12868	CAPE KENNEDY FLA	N2829	W08033	9
76459	22009	MAZALTAN MEXICO	N2312	W10625	36
76644	12878	MERIDA YUC INT APT MEXICO	N2056	W08940	30
76679	11903	MEXICO CITY/TACUBAYA MEX	N1924	W09912	7564
76692	11904	VERA CRUZ MEX	N1911	W09607	43
78016	13601	KINDLEY AFB BERMUDA	N3222	W06441	82
78063	12712	GOLD ROCK CREEK BAHAMAS	N2637	W07822	19
78076	12713	COFFIN HILLS BAHAMAS	N2516	W07618	33
78089	12716	SAN SALVADOR AAFB BAHAMAS	N2404	W07437	UNK
78118	12714	GRAND TURK AAFB TURKS CAIC	N2127	E07109	30
78224	12864	HAVANA CUBA	N2309	W08222	UNK
78255	12711	CAMAGUEY CUBA	N2125	W 7752	402
78367	11706	GUANTANAMO.BAY CUBA	N1954	W07509	54
78383	11813	GRANDCAYMAN BWI	N1918	W08122	10
78397	11715	KINGSTON JAM	N1756	W07647	24
78467	11646	SABANA DE LA MAR DR	N1903	W36923	36
78501	00024	SWAN IS WI	N1724	W08356	35
78526	11641	SAN JUAN PUERTO RICO	N1826	W06600	72
78807	1 701	BALBAO CANAL ZONE	N0857	W 7934	41
78861	11647	ANTIGUA LEEWARD IS BR	N1707	W06147	12
78897	11642	RAIZET F LEEWARD IS	N1616	W06132	26
78967	11621	TRINIDAD/USNS BWI	N1041	W06137	42
78988	11643	WILLEMSTAD CURACAO NWI	N1212	W 6858	27
80001	11814	SAN ANDRES IS COLUMBIA	N1235	W08142	30
91066	22701	MIDWAY NAS HAW IS	N2813	W17723	13
91165	22536	LIHUE WBAP KAUAI HAW IS	N2159	W15921	147
91217	41415	TAGUAC GUAM POLYNESIA	N1333	E14450	364
91245	41606	WAKE IS INT APT WBO	N1917	W16639	14
91250	41601	ENIWETOK MARSHALL IS	N1121	E16221	12

STATION LOCATOR LIST

WMO	WBAN	NAME	LATITUDF	LONGITUDE	ELEVATION
91275	21601	JOHNSTON IS AFB	N1644	W16931	7
91285	21504	HILO WBAP HAWAIIAN IS	N1943	W15504	116
91334	40505	TRUK WBO CAROLINF IS	N0728	E15151	118
91348	40504	PONAPE CAROLINE IS	N0658	E15813	10
91408	40309	PALAU/KOROR CAROLINE IS	N0720	E13429	371
91413	40308	YAP NAV CAROLINE IS POLY	N0931	E13808	51
98327	41207	CLARK AFB PHILIPPINES	N1511	E12033	478
99007	00002	SHIP 4YB	N5630	W05100	
99008	00003	SHIP 4YC	N5245	W03530	
99009	00004	SHIP4YD	N4400	W04100	
99010	00005	SHIP 4YE	N3500	W04800	
99016	00011	SHIP 4YK	N4500	W01600	
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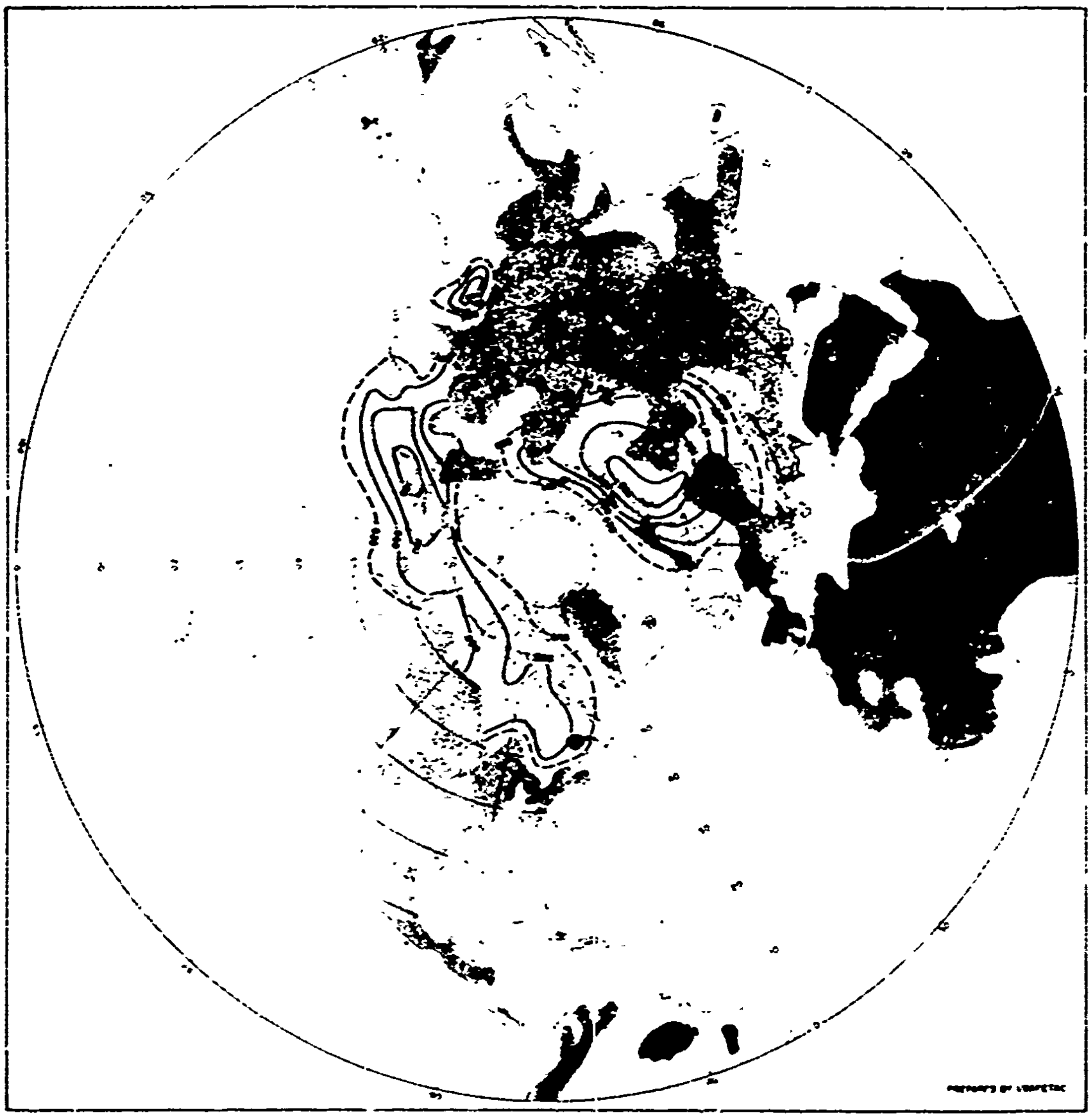
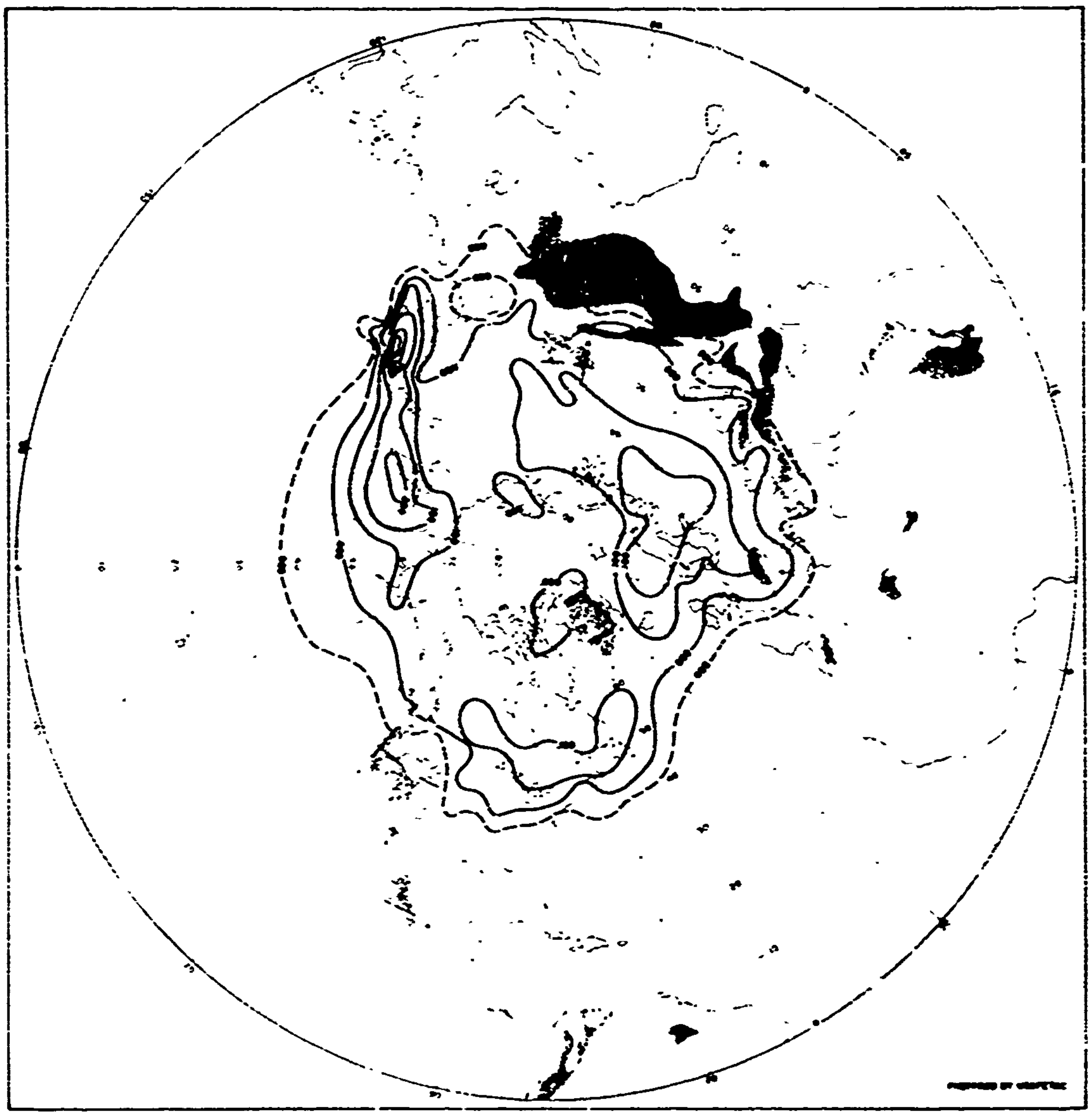


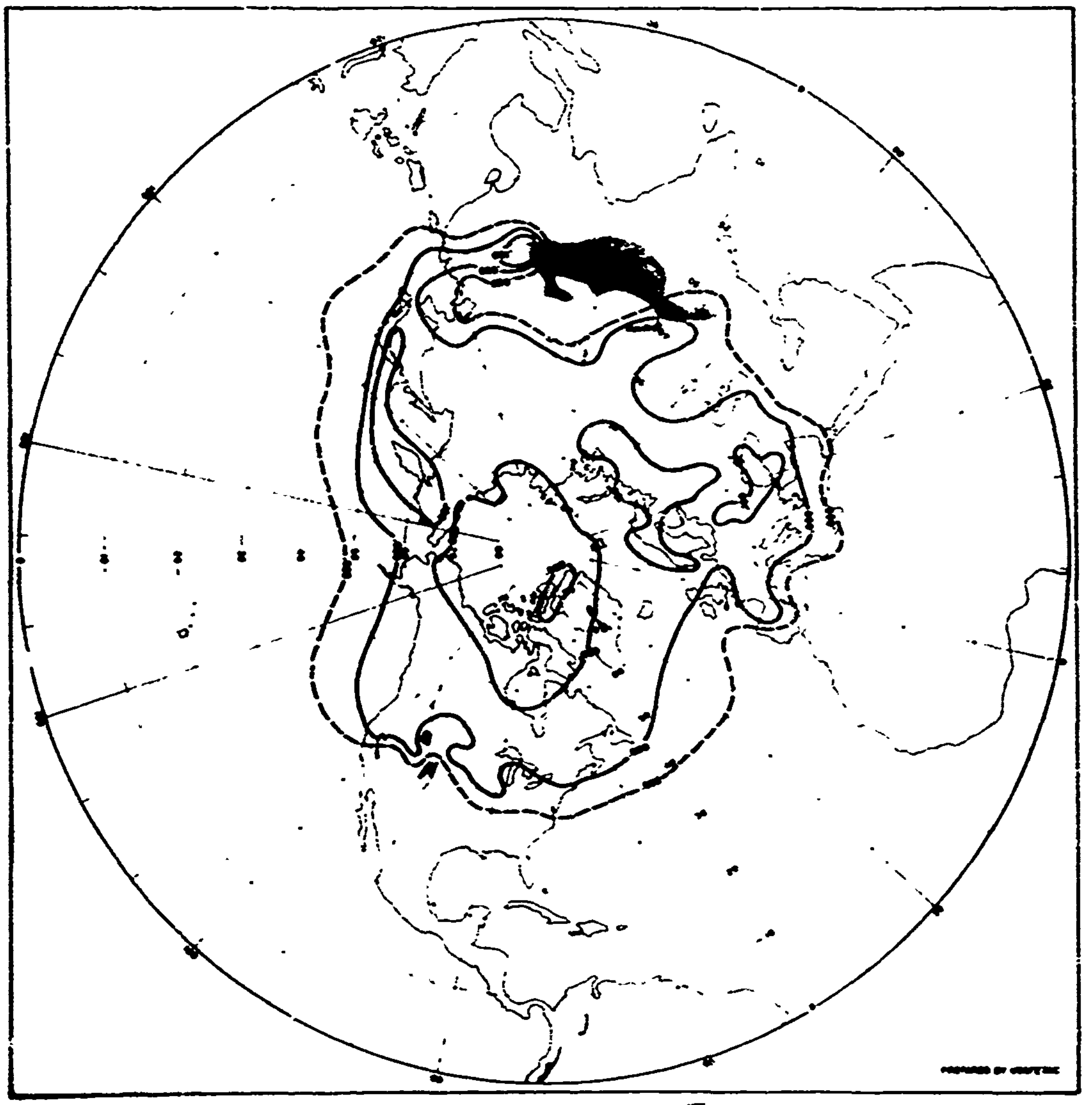
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
1000 MB JANUARY

Figure B-1



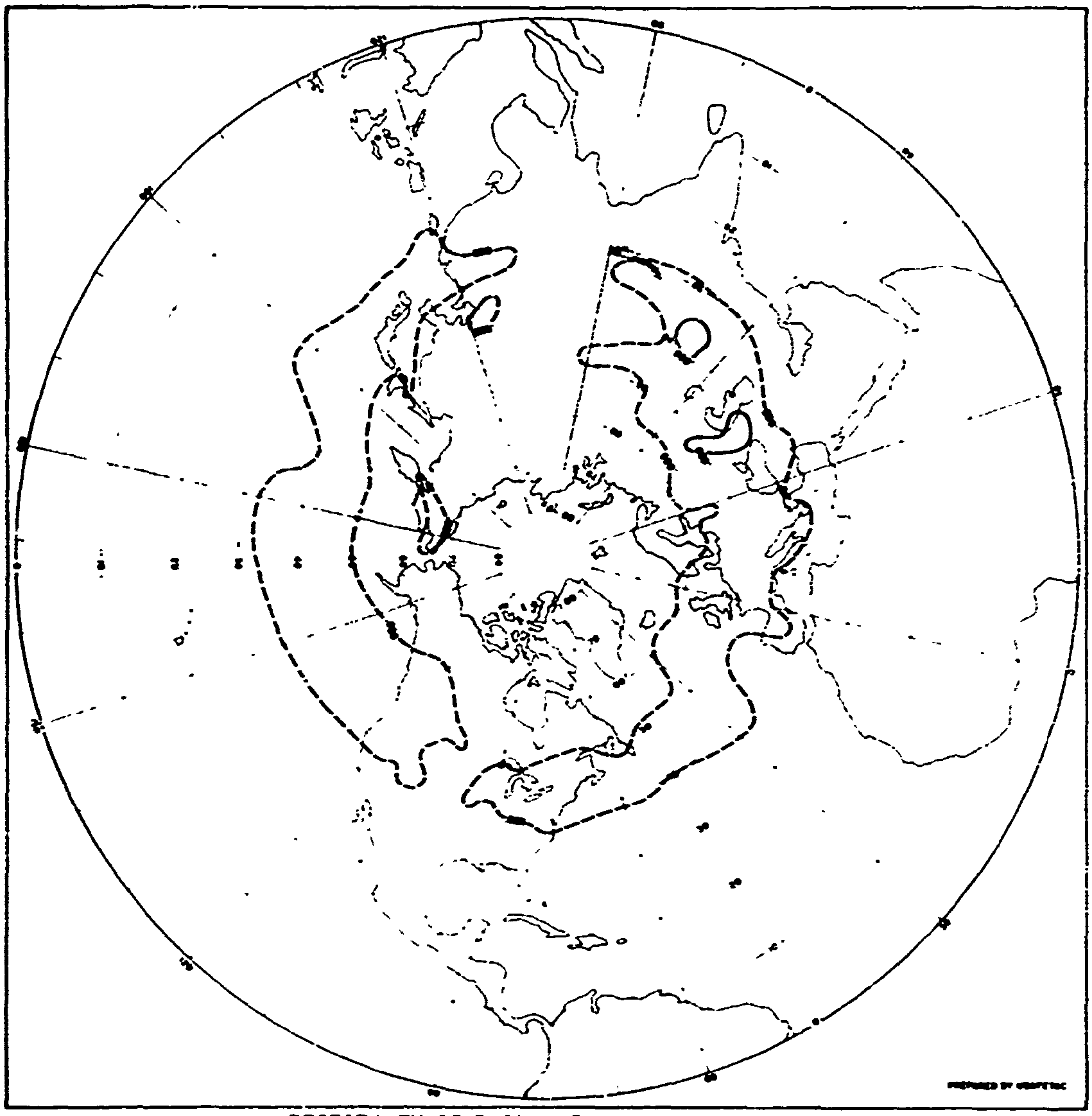
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
850 MB JANUARY

Figure B-2



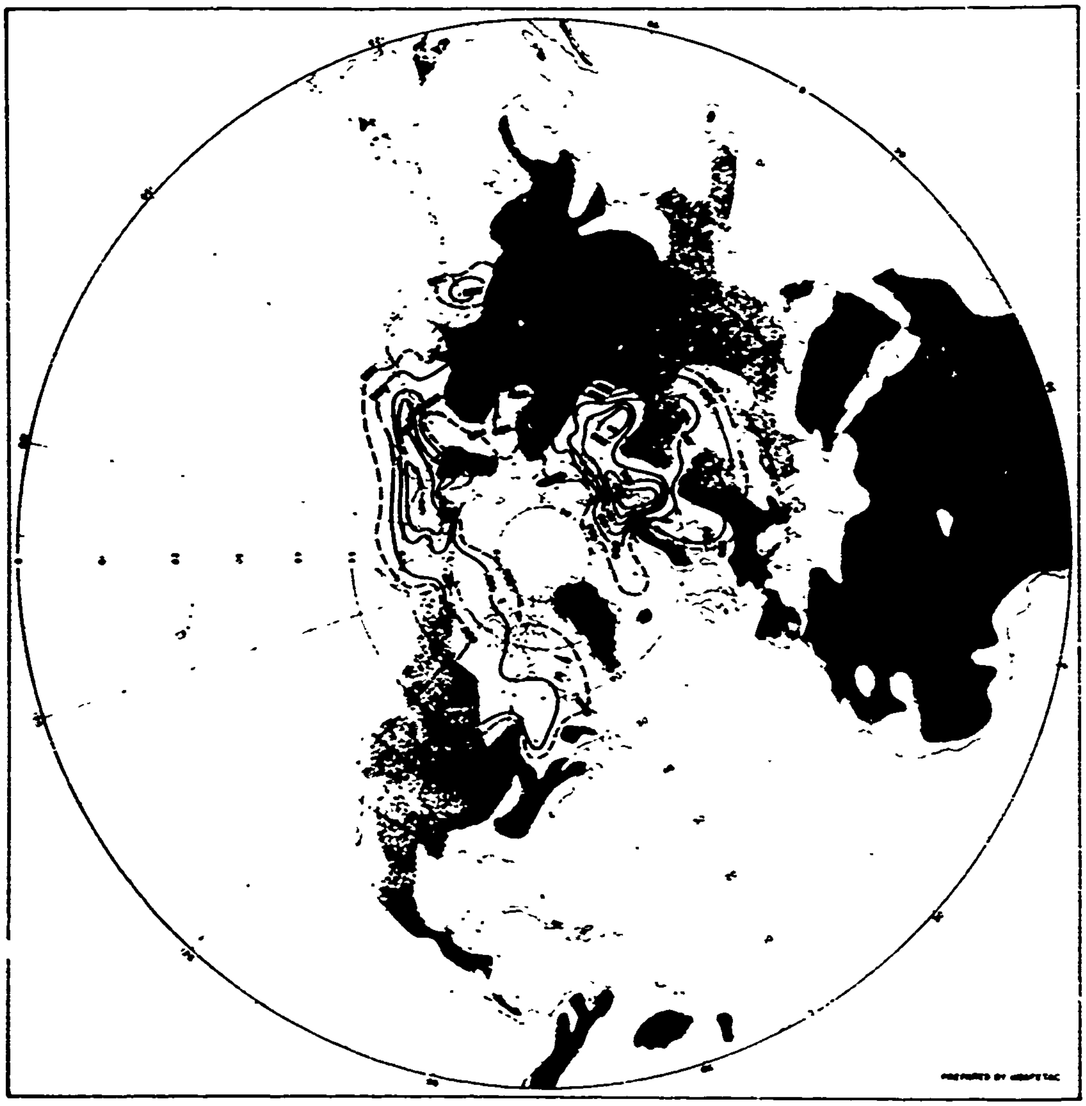
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
700 MB JANUARY

Figure B-3



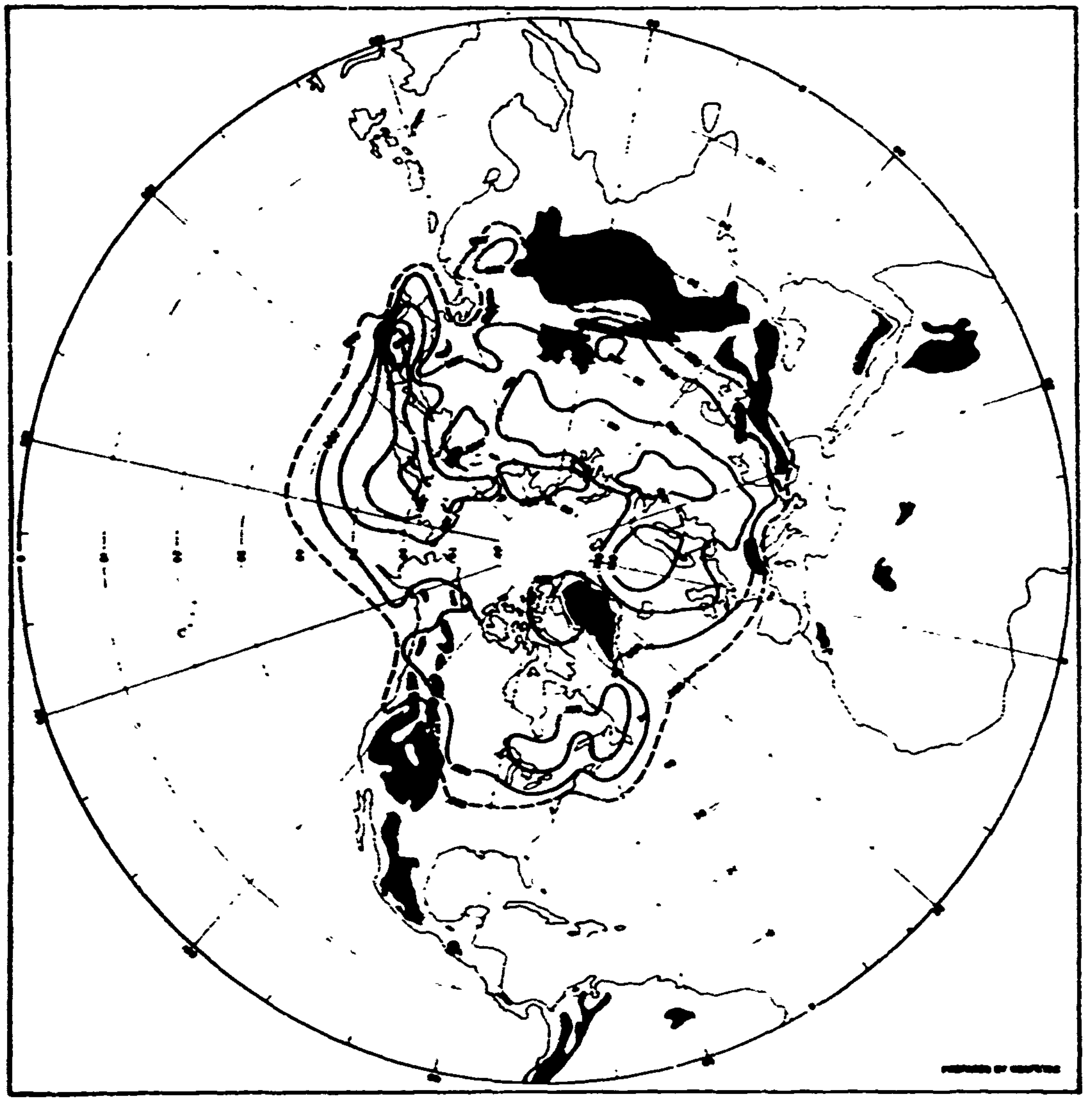
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
500 MB JANUARY

Figure B-4



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
1000 MB FEBRUARY

Figure B-5



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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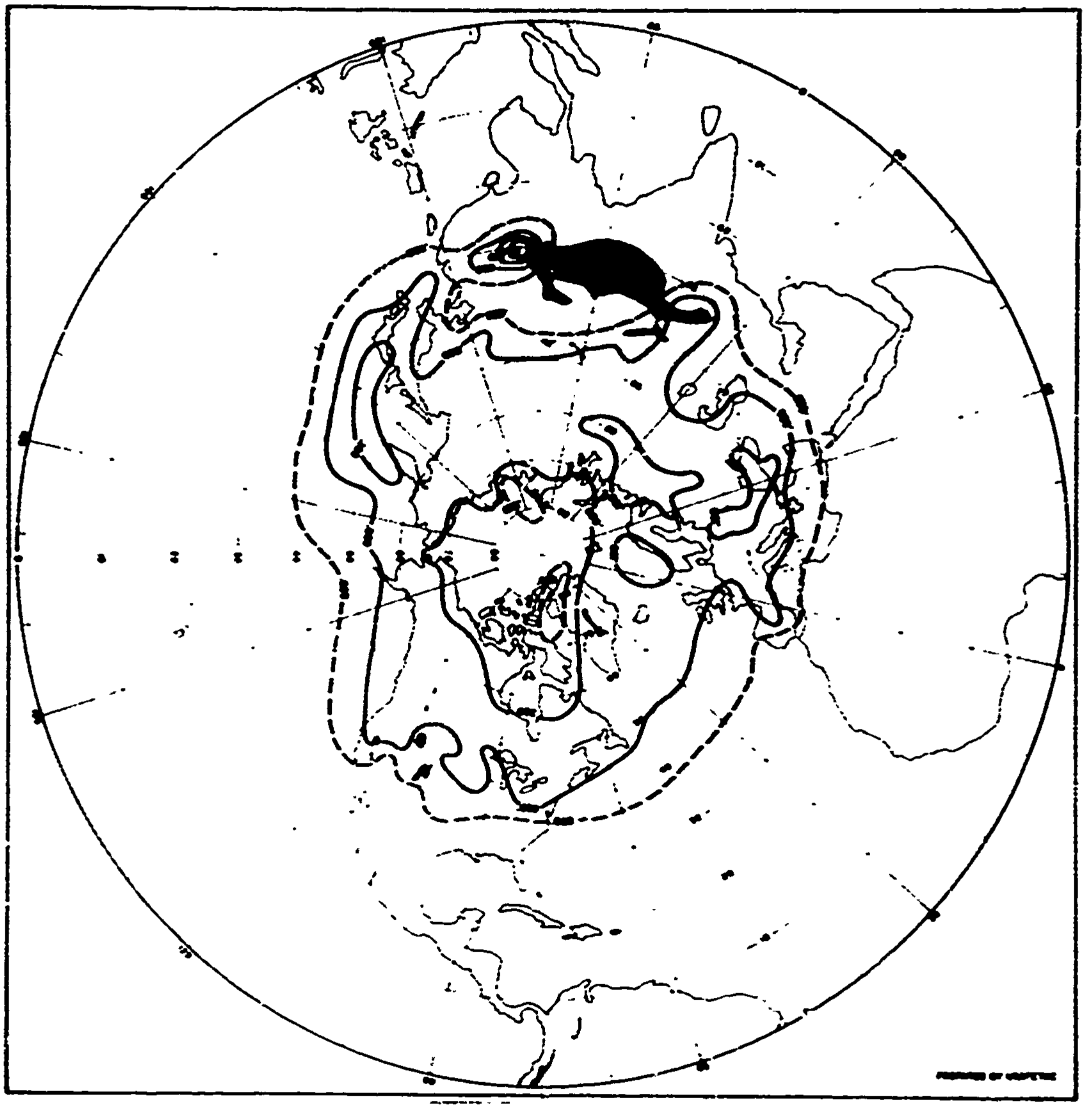
Figure B-6



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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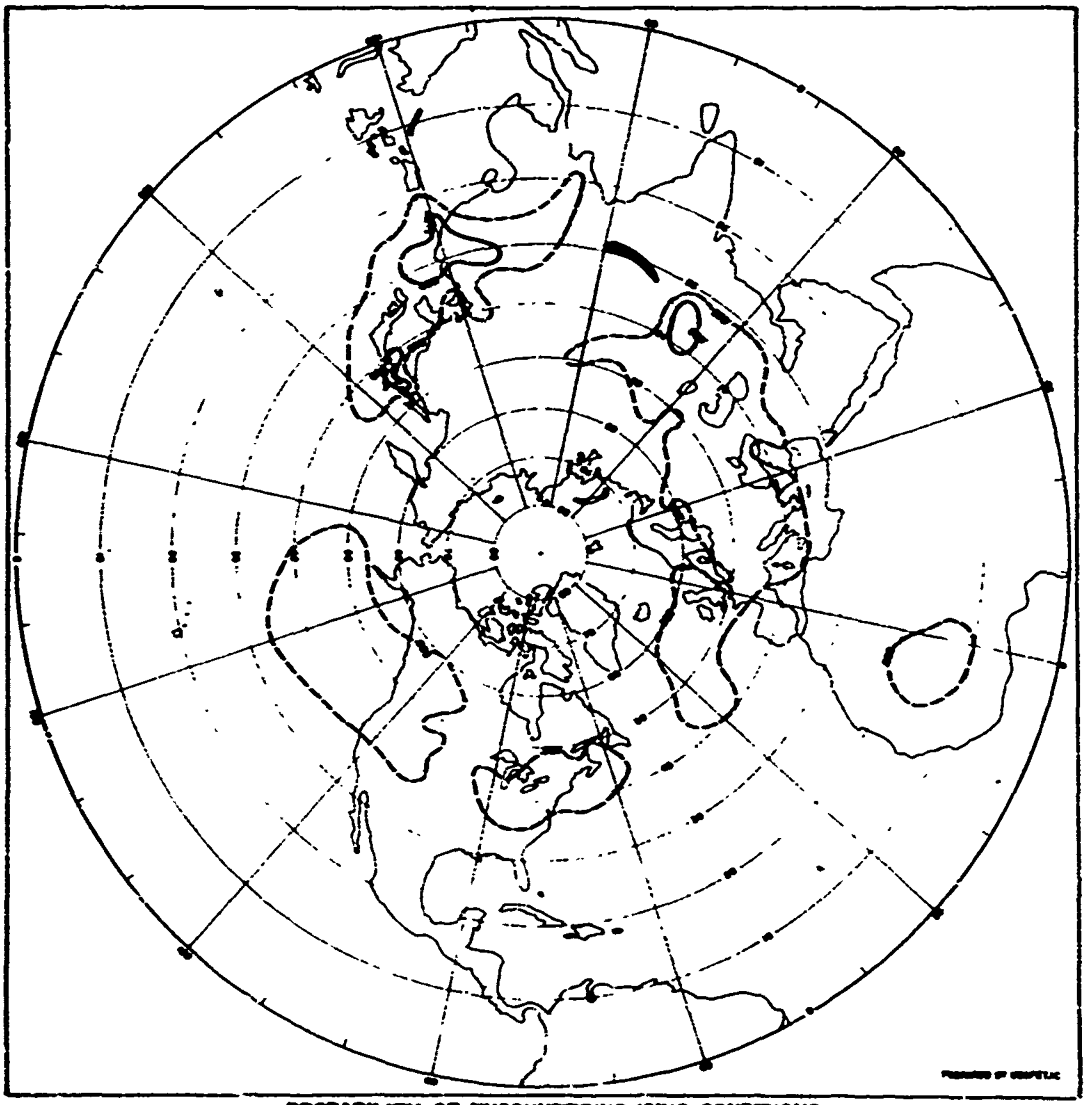
Figure B-7



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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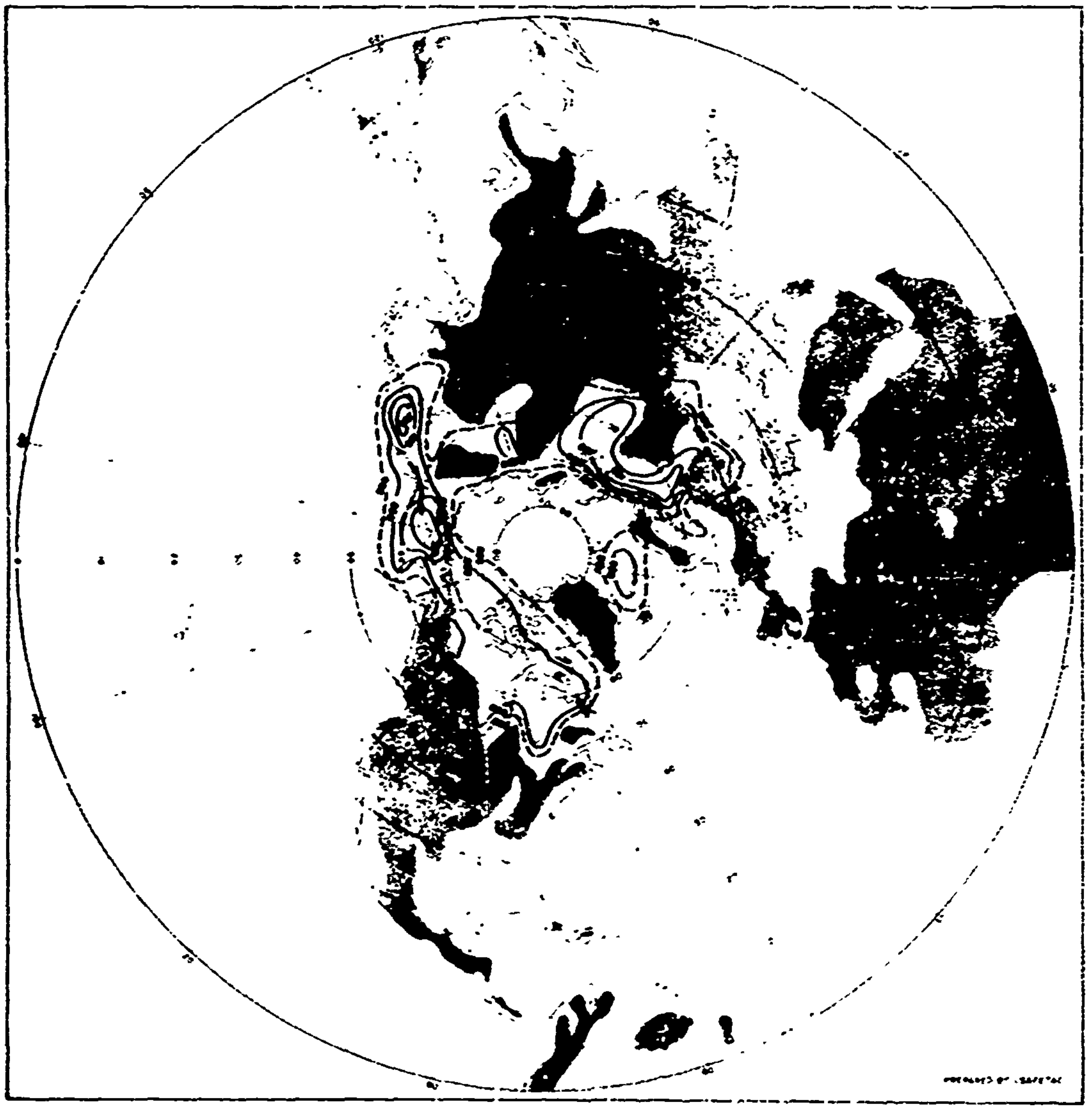
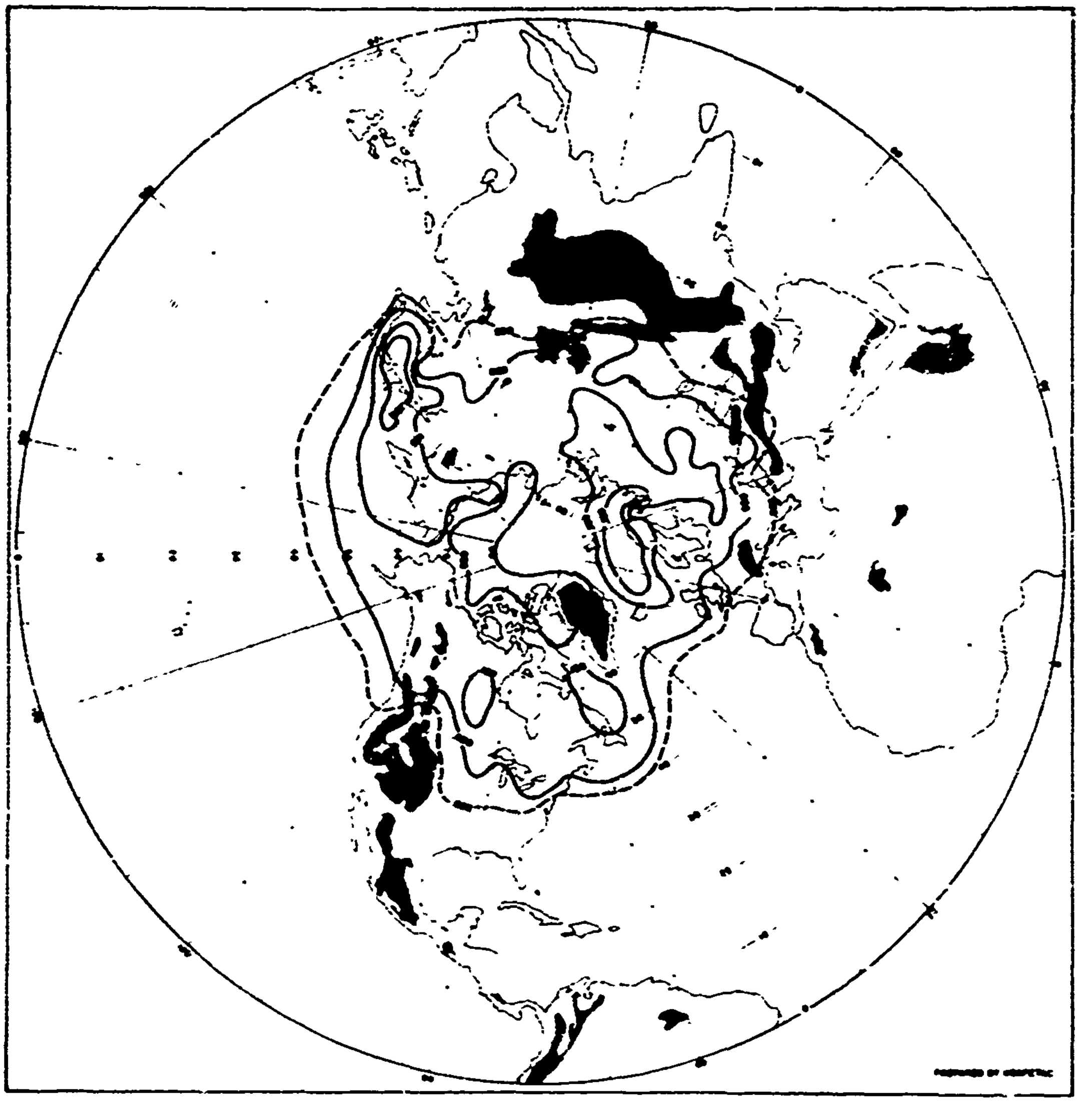
Figure B-8



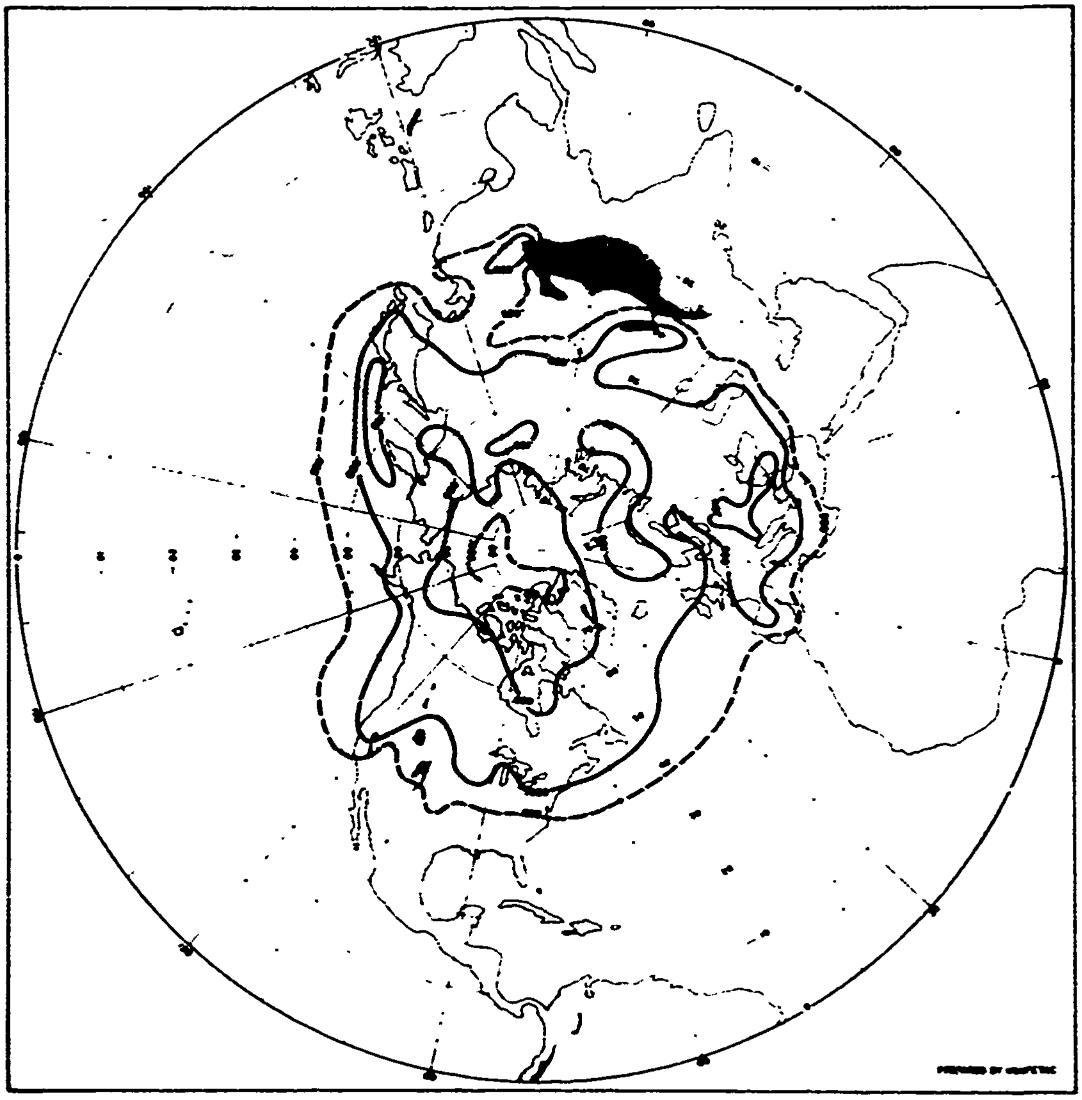
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
1000 MB MARCH

Figure B-9



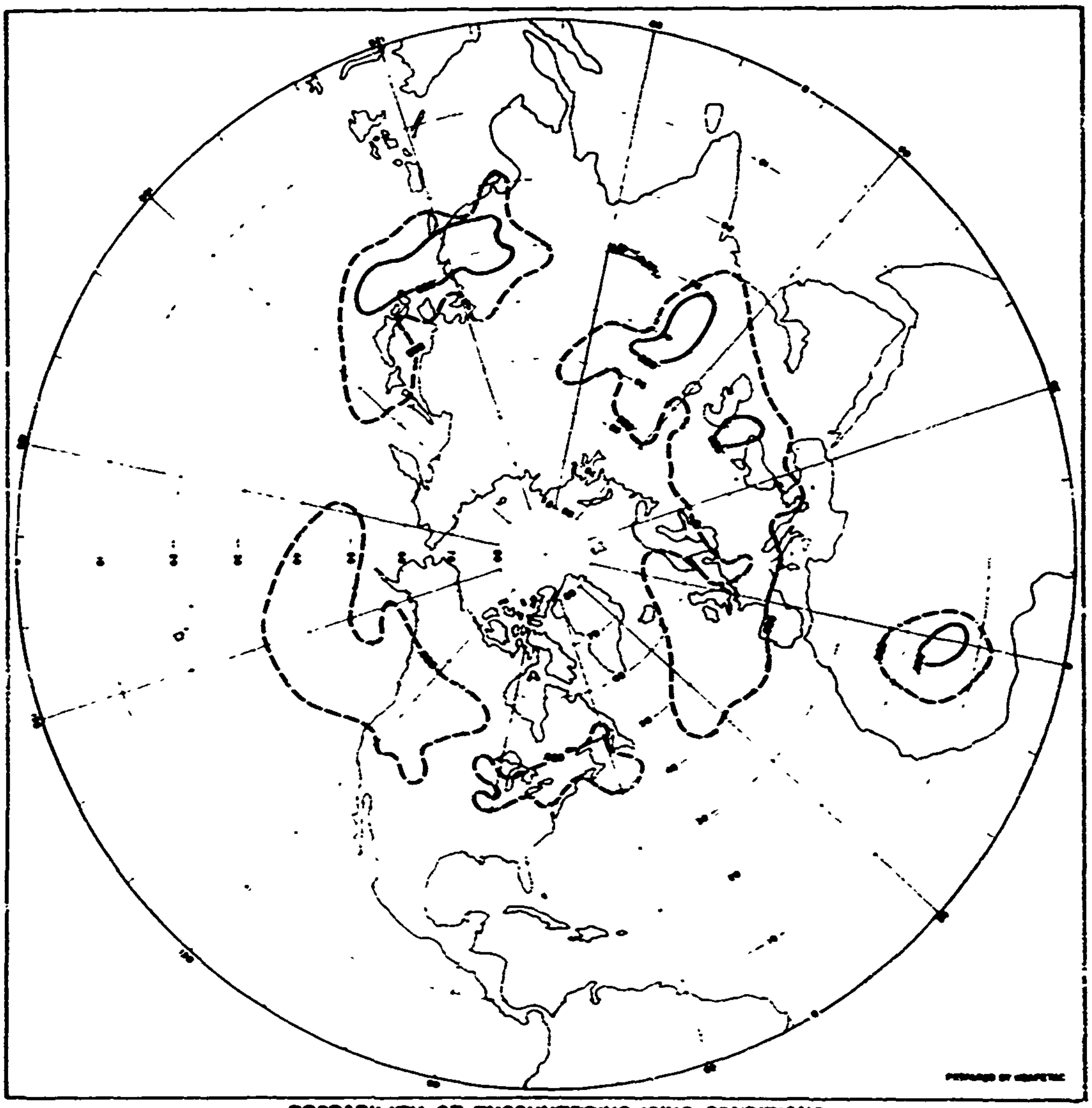
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
850 MB MARCH

Figure B-10



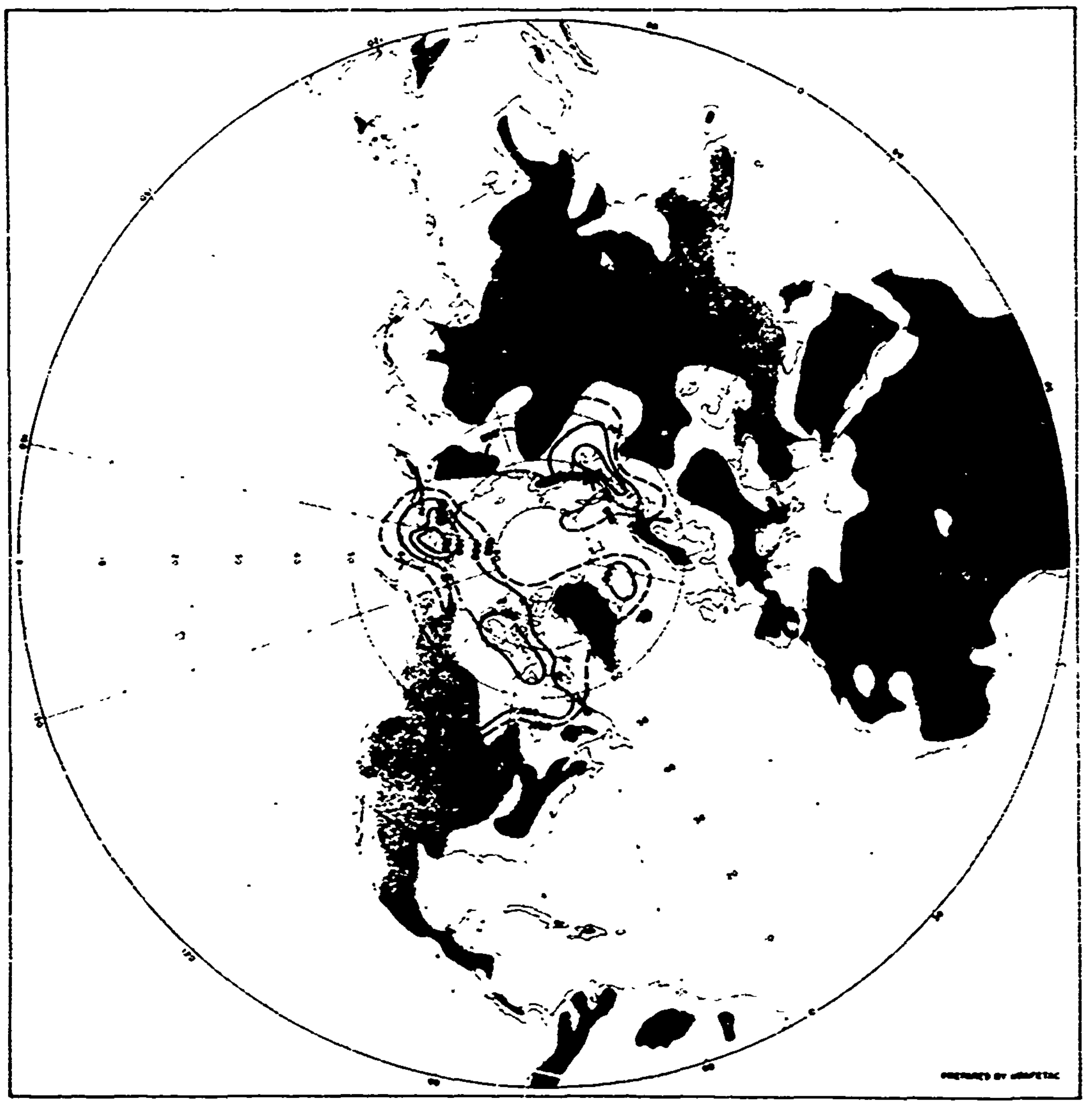
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
700 MB MARCH

Figure B-11



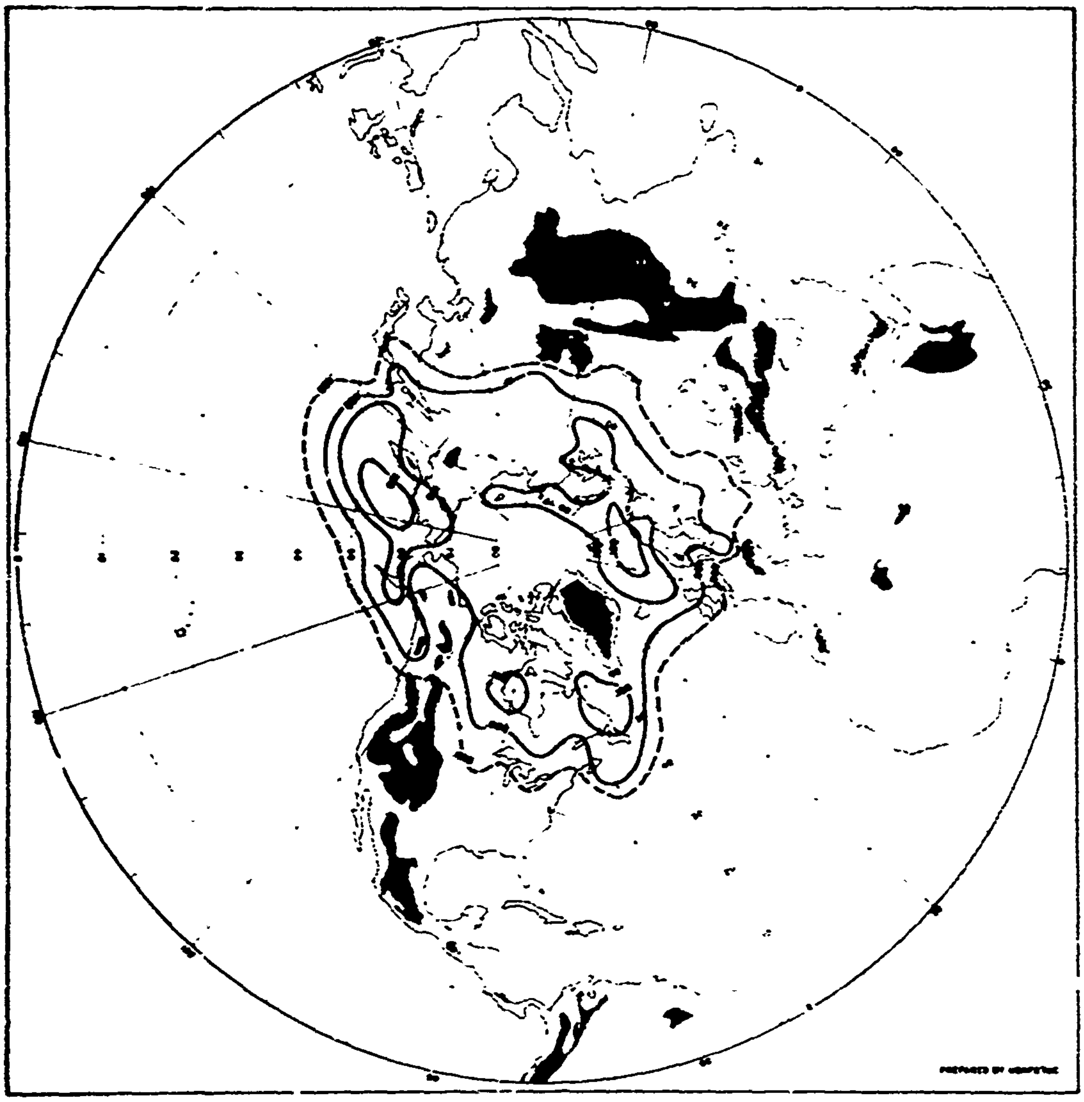
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
500 MB MARCH

Figure B-12



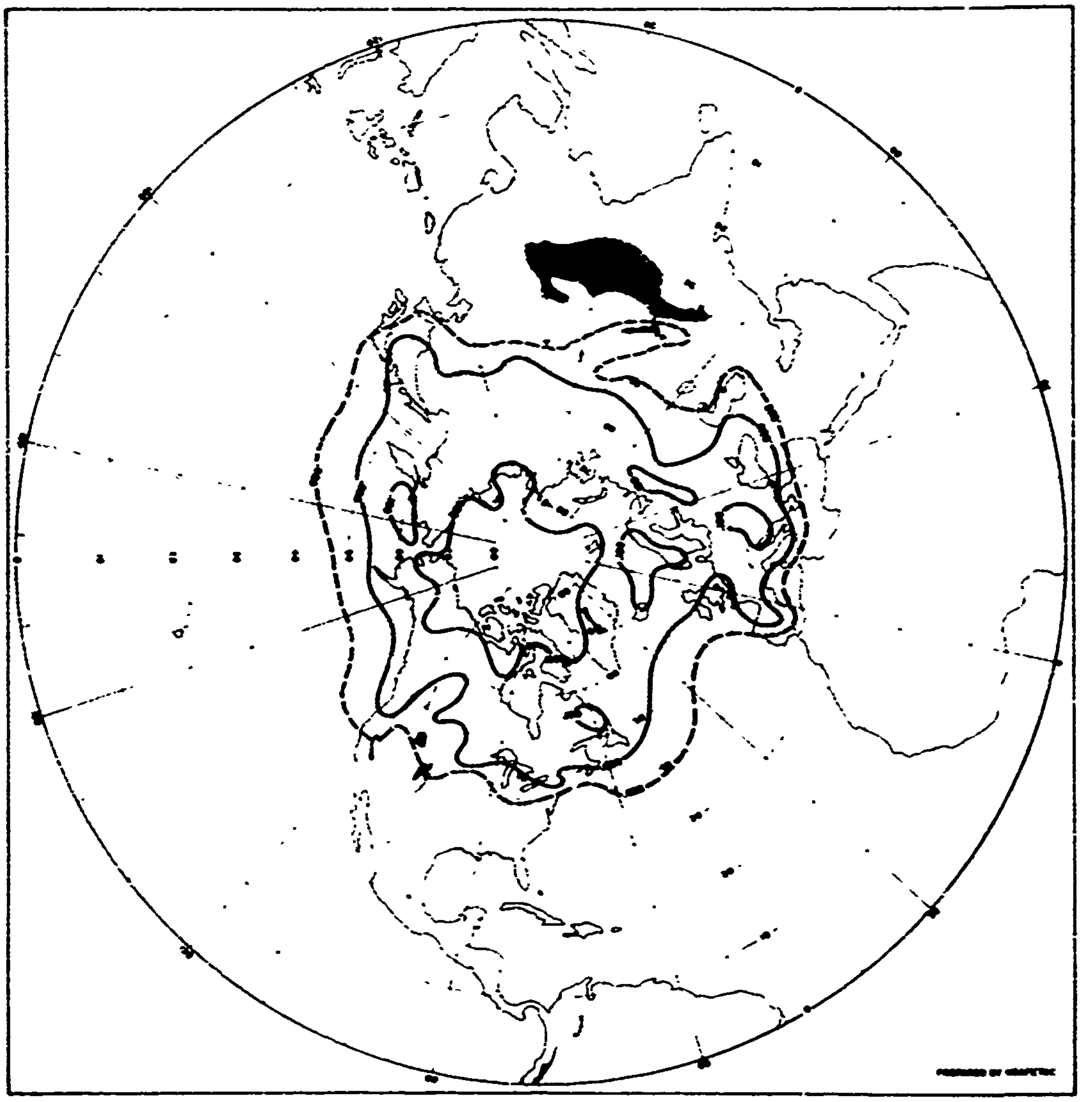
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
1000 MB APRIL

Figure B-13



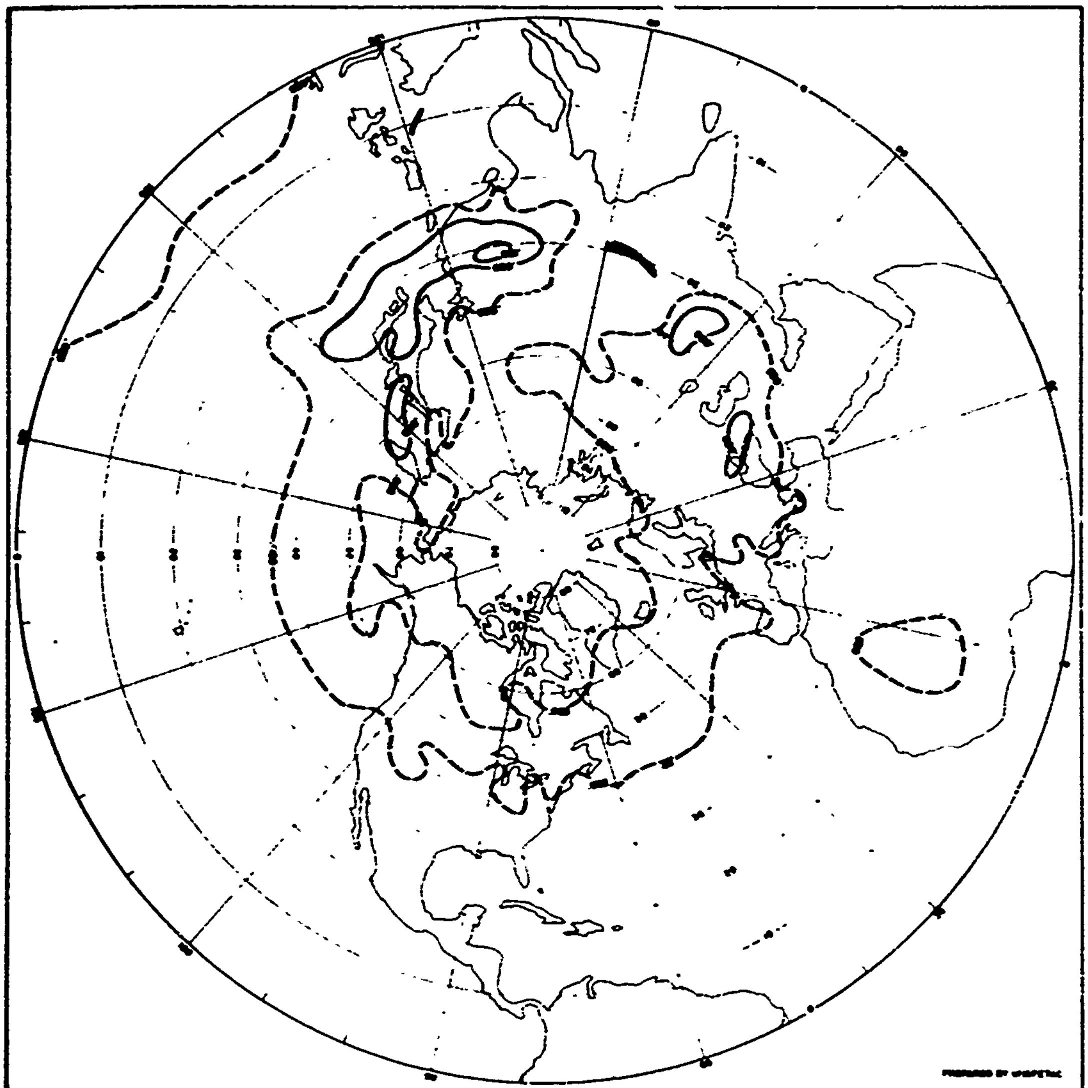
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
850 MB APRIL

Figure B-14



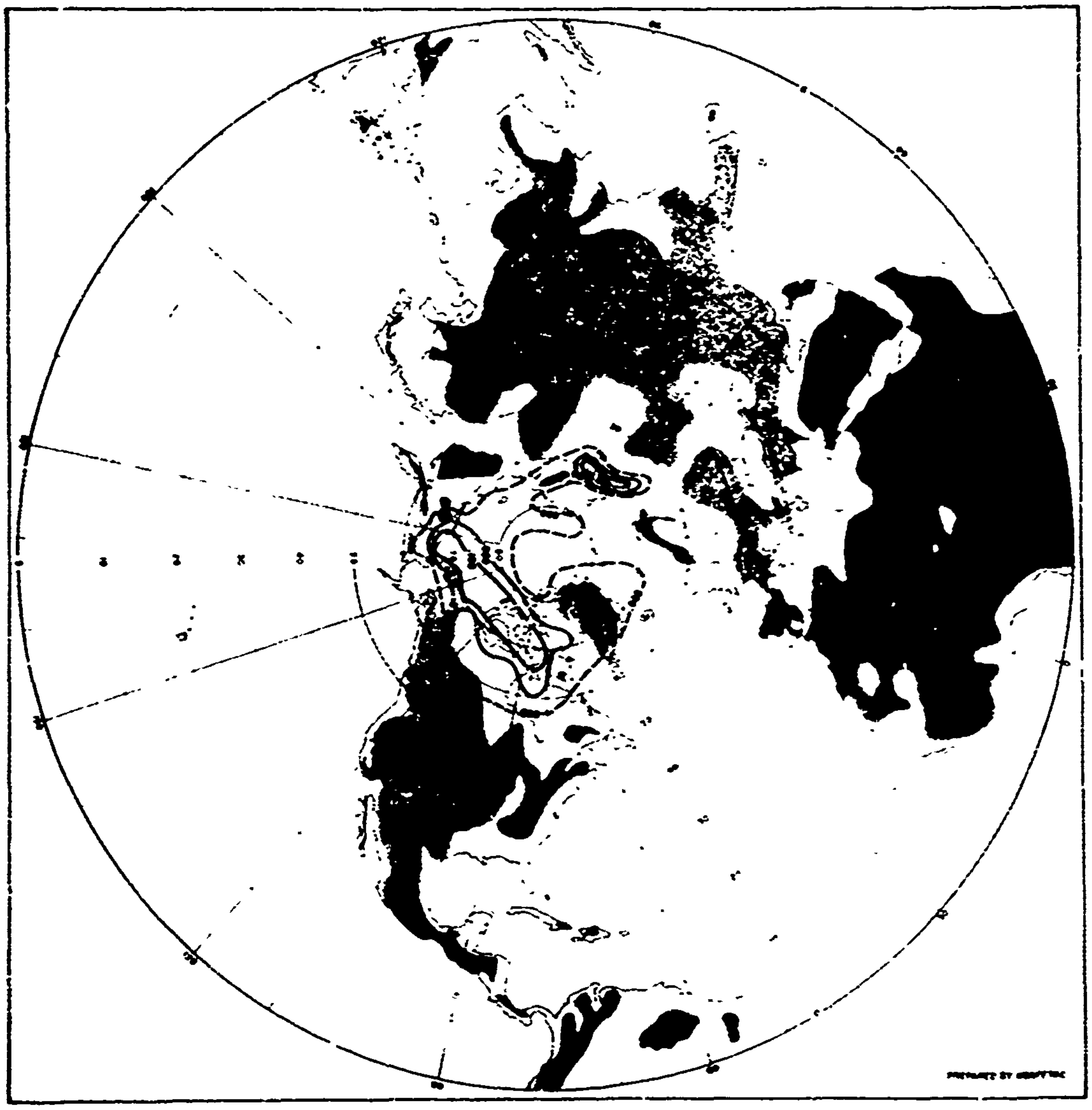
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
700 MB APRIL

Figure B-15



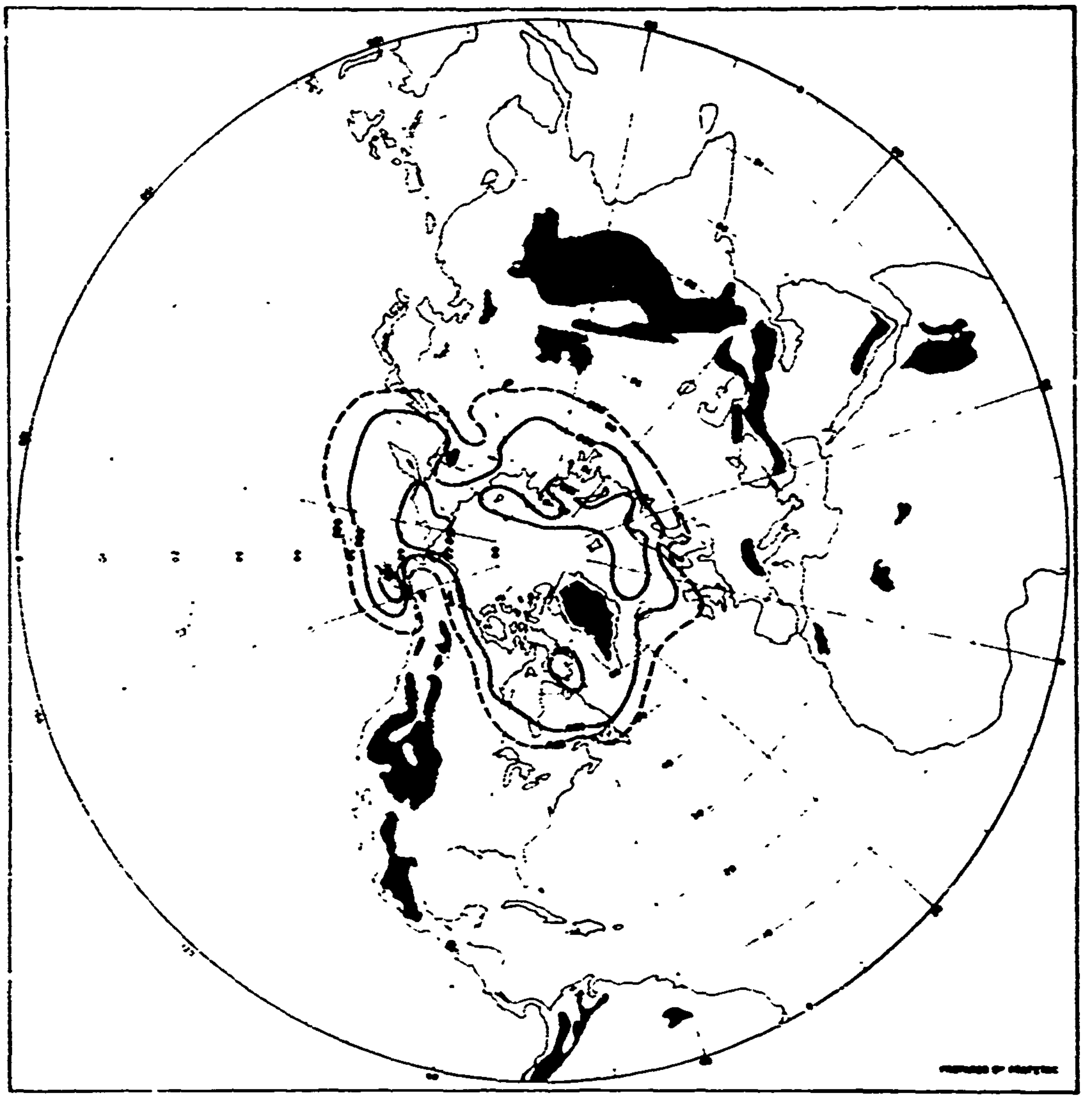
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
500 MB APRIL

Figure B-16



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
1000 MB MAY

Figure B-17



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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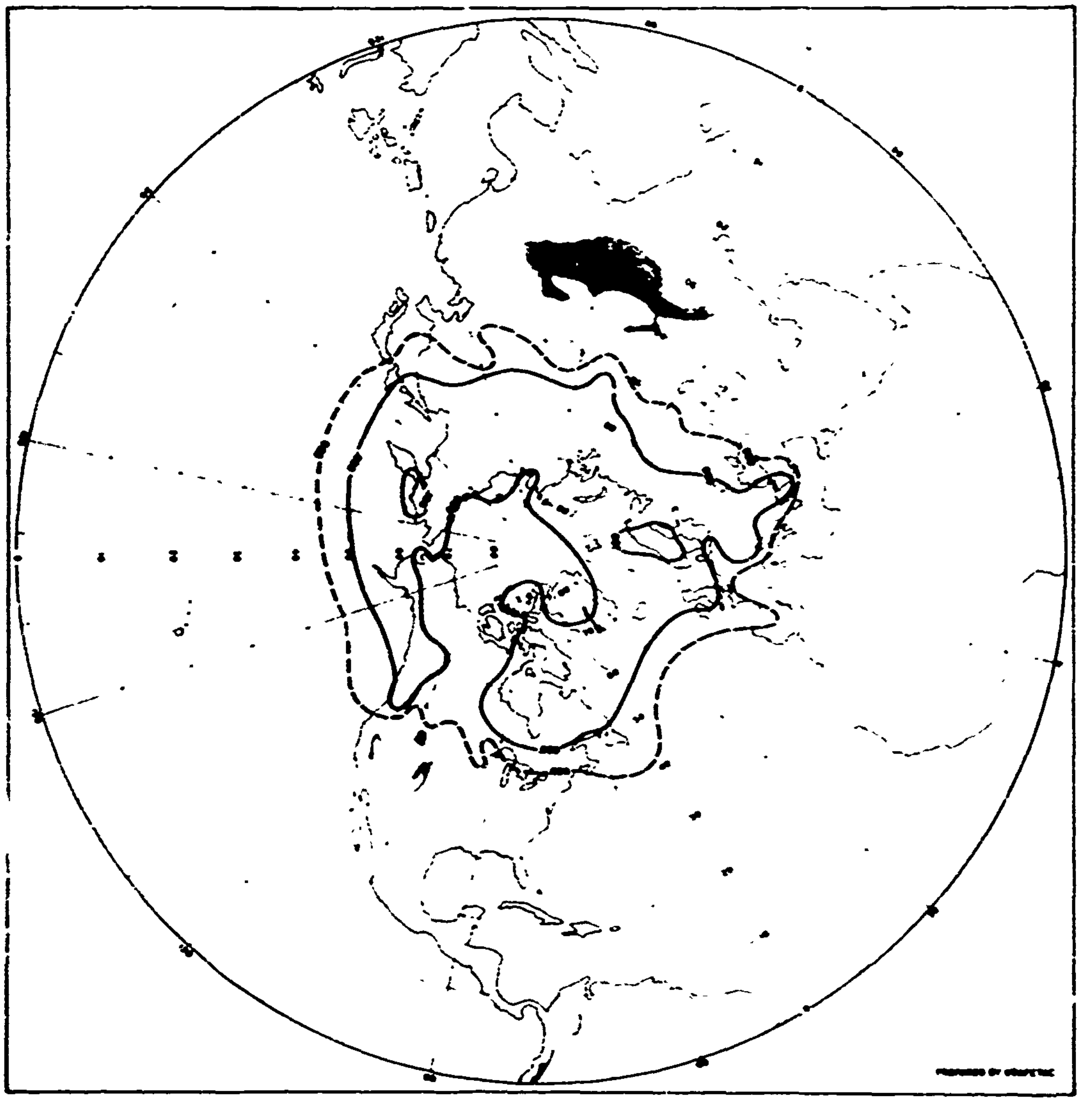
Figure B-18



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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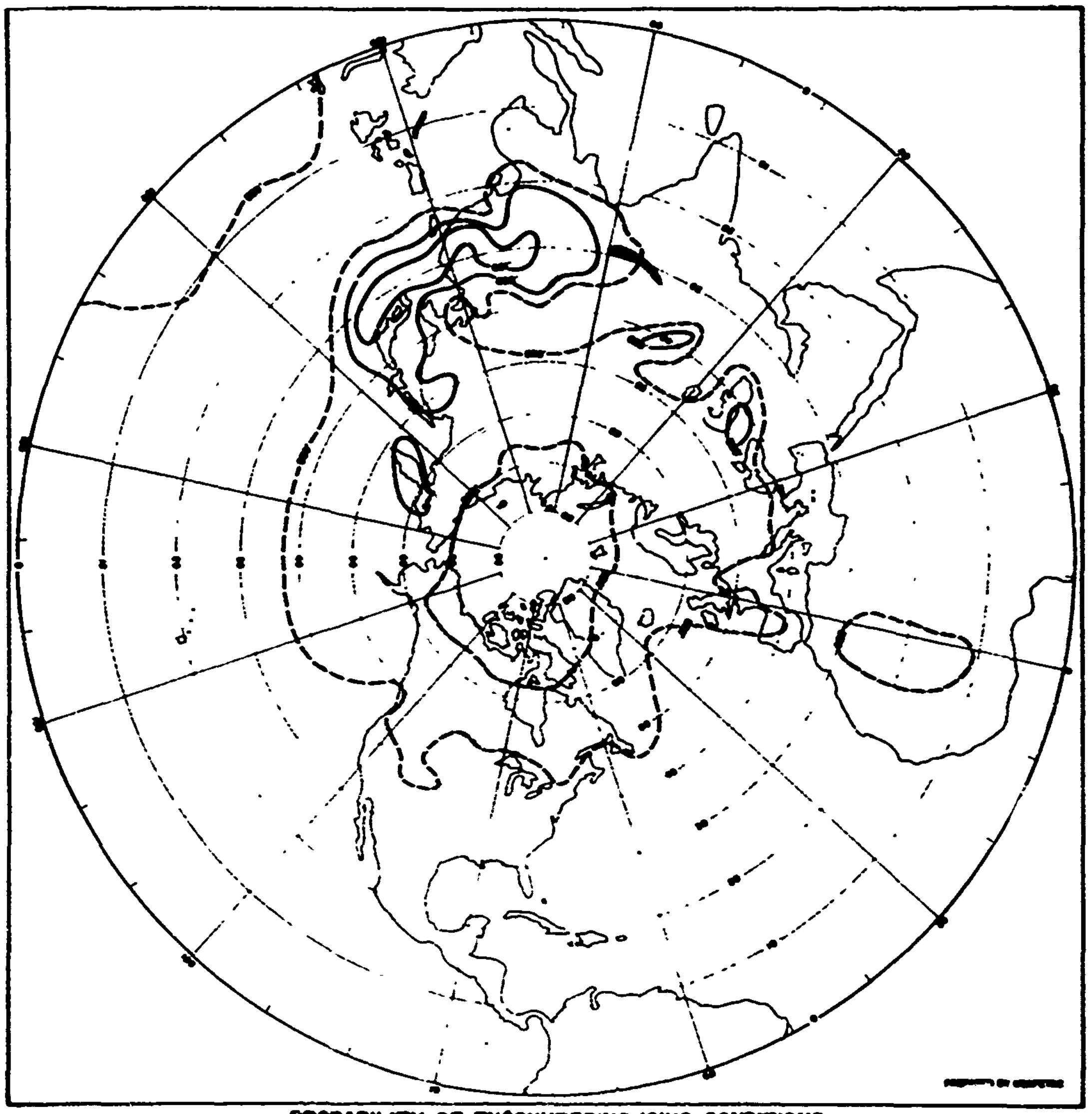
Figure B-19



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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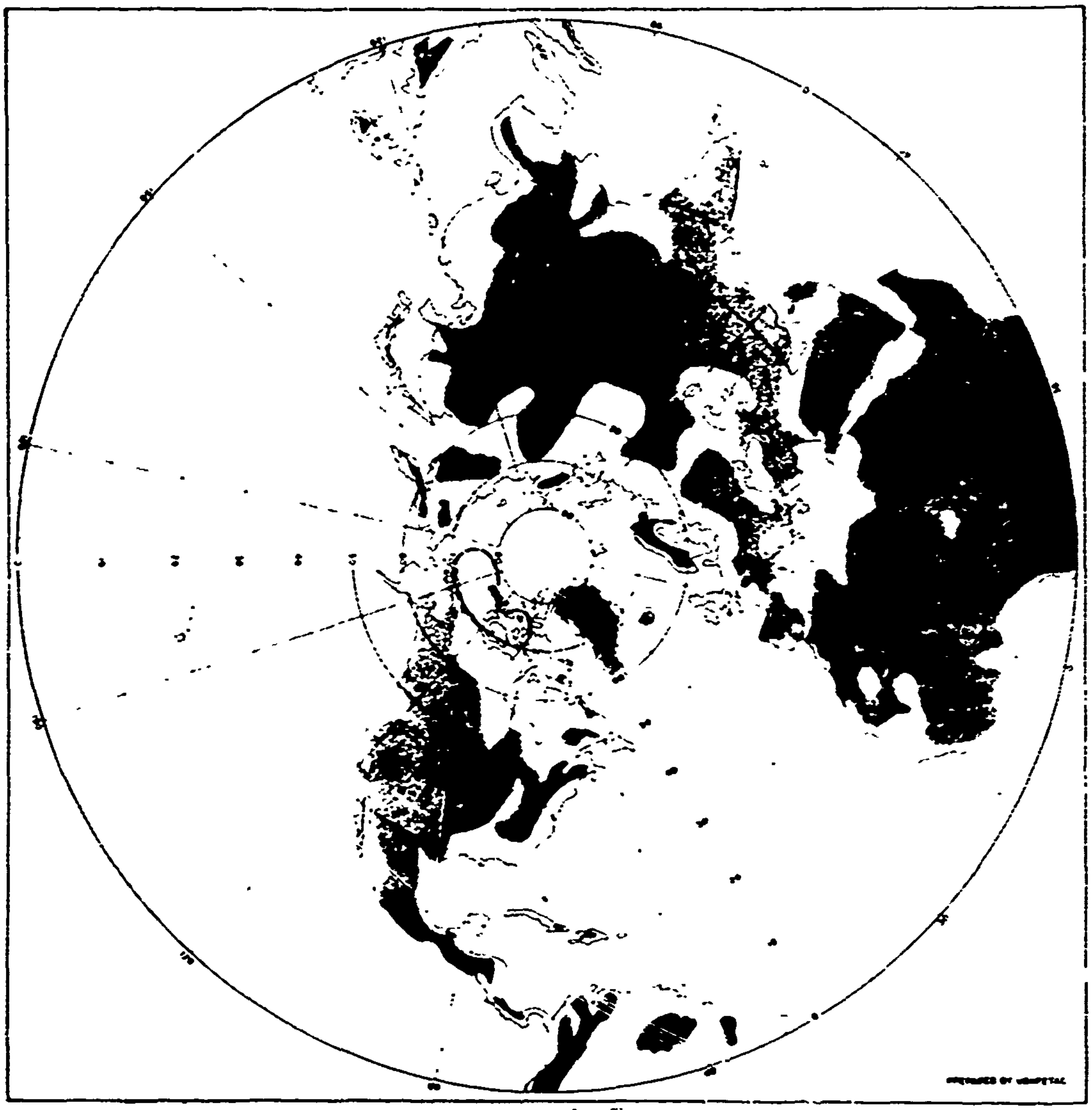
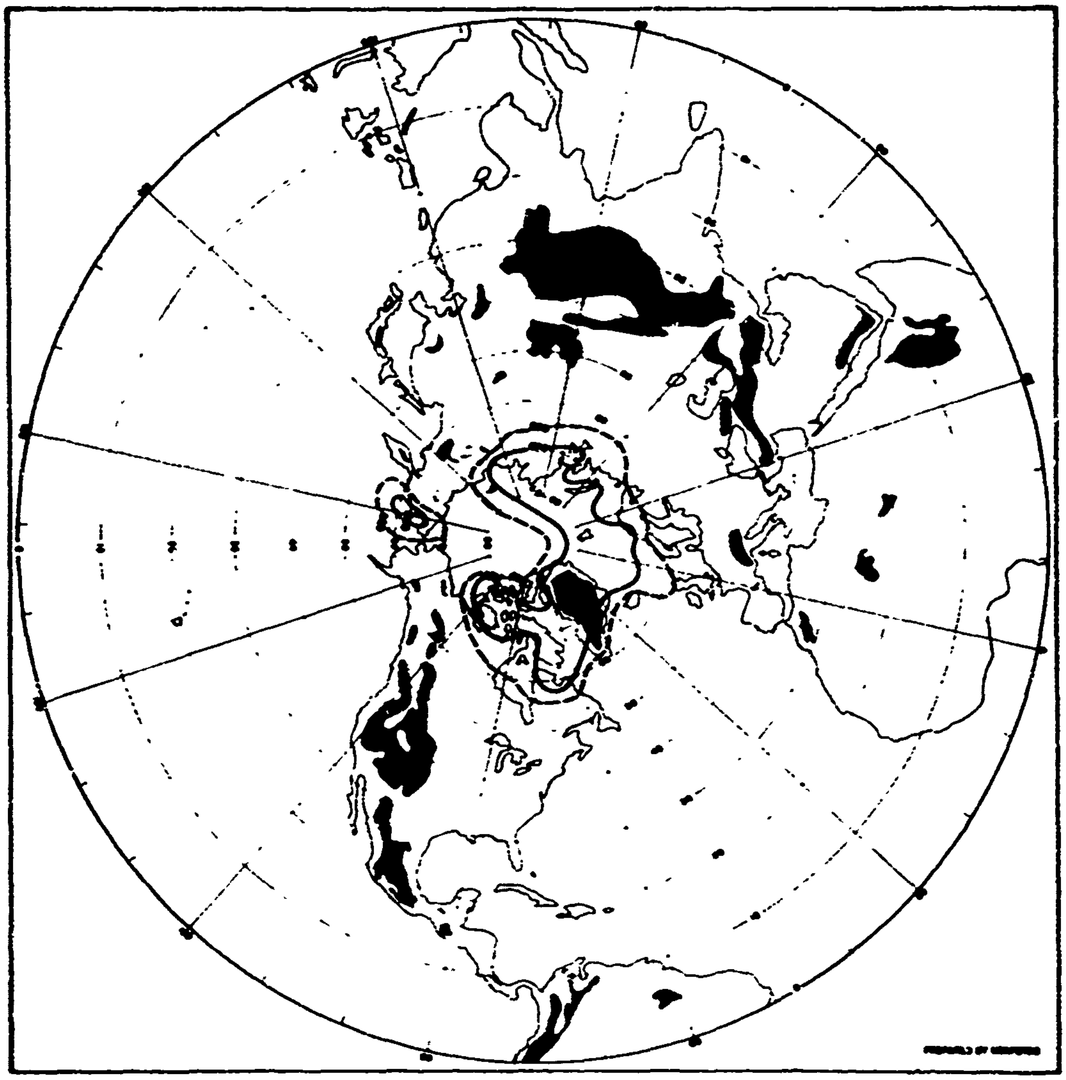
Figure B-20



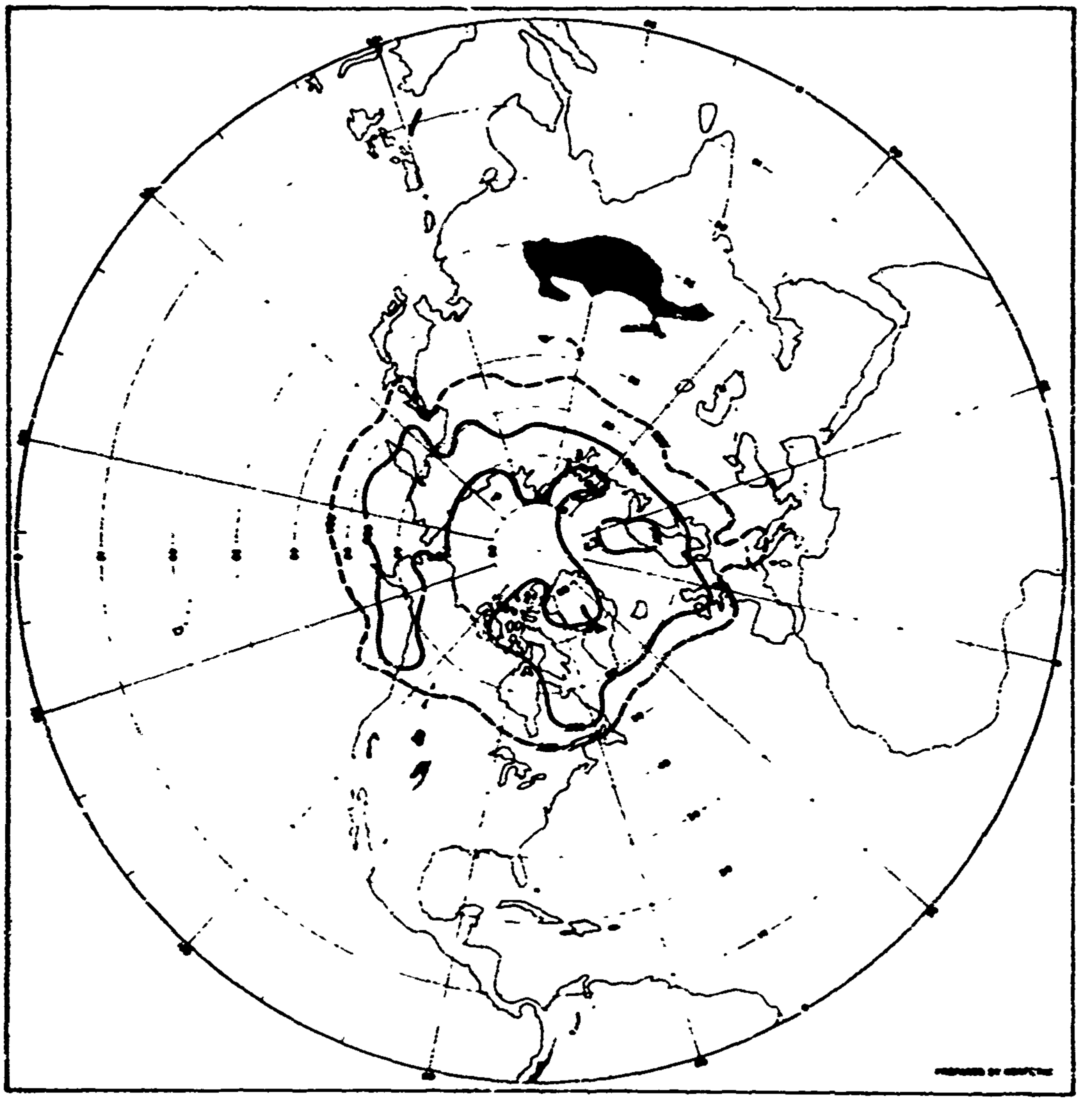
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
1000 MB JUNE

Figure B-21



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
850 MB JUNE

Figure B-22



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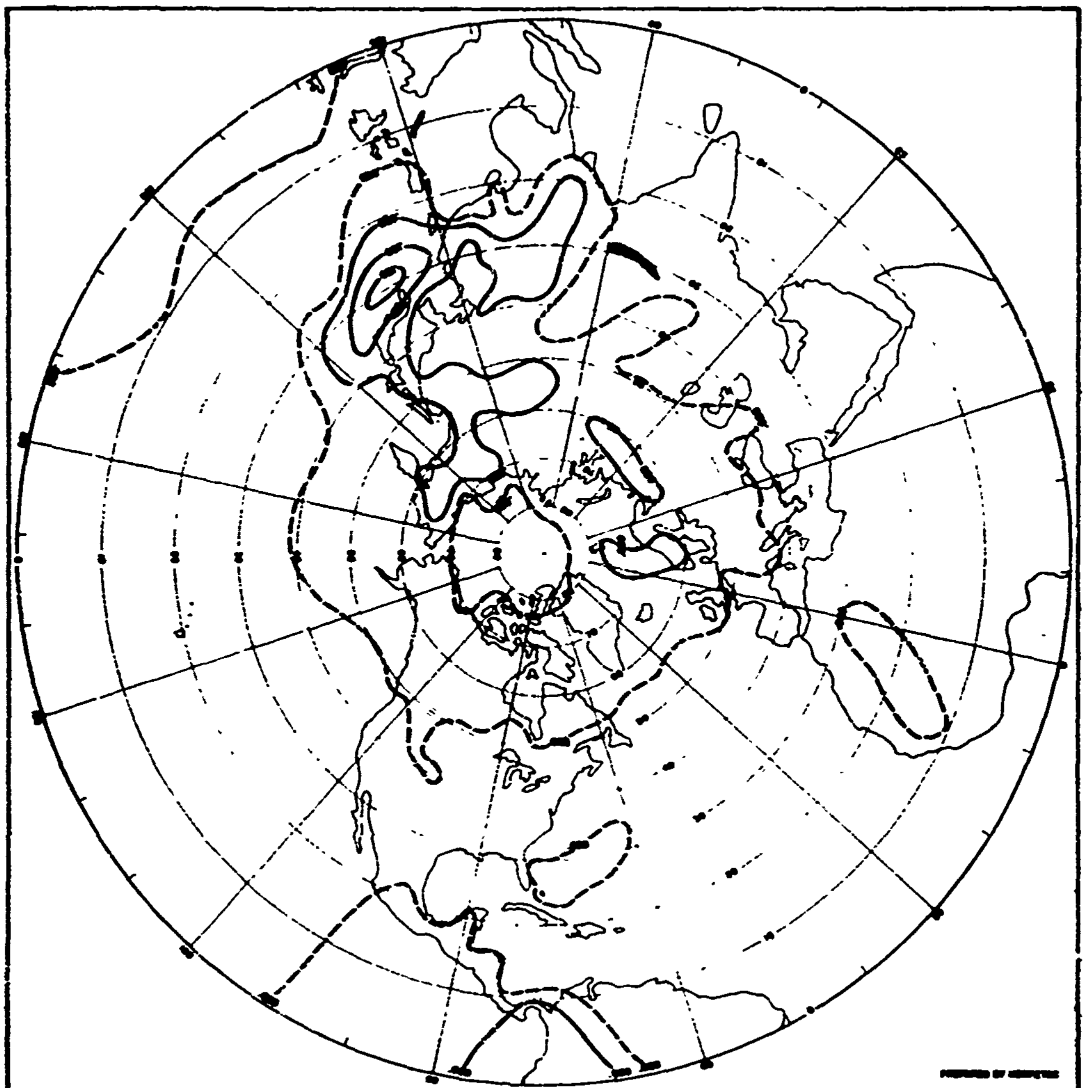

PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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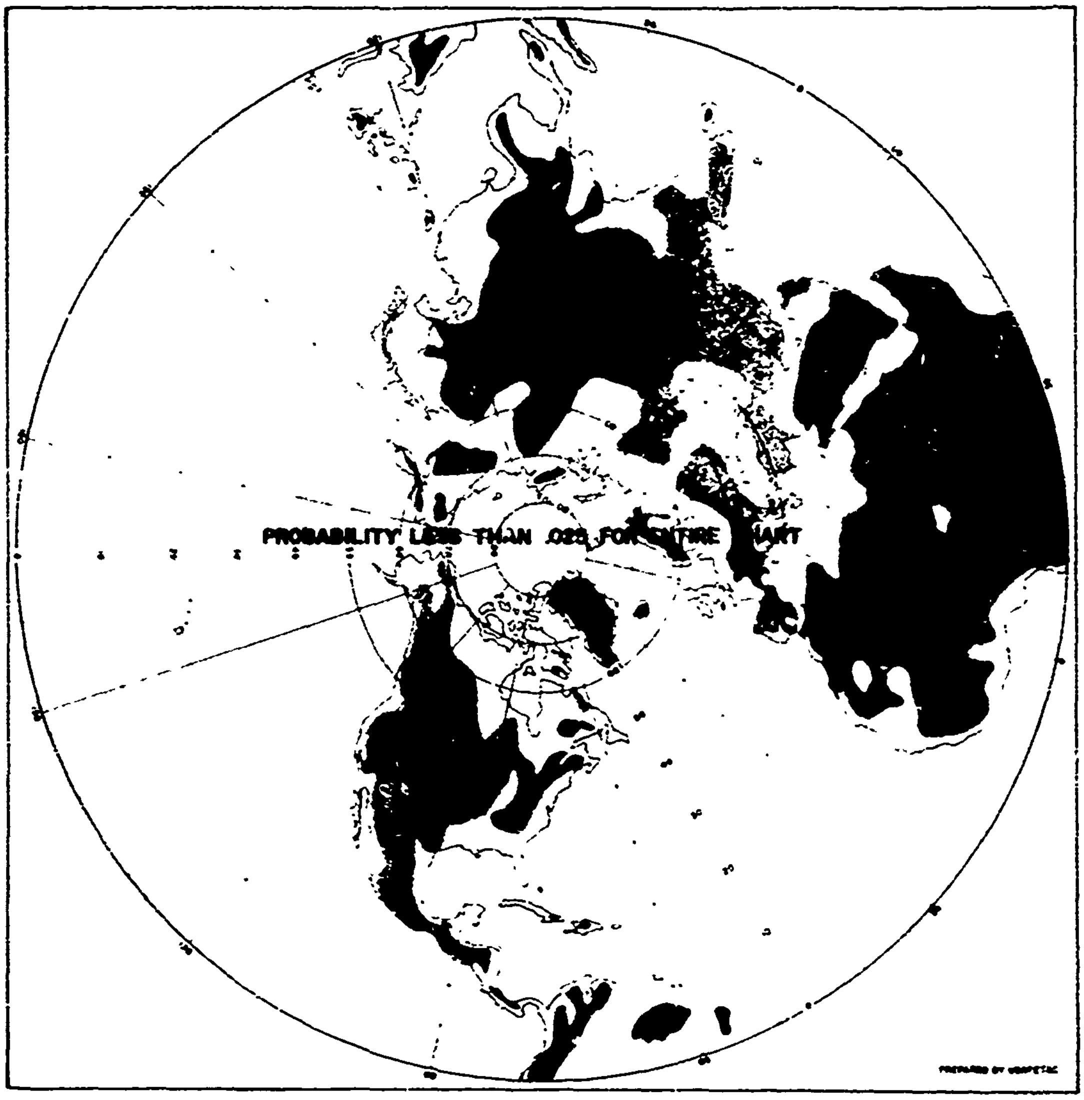
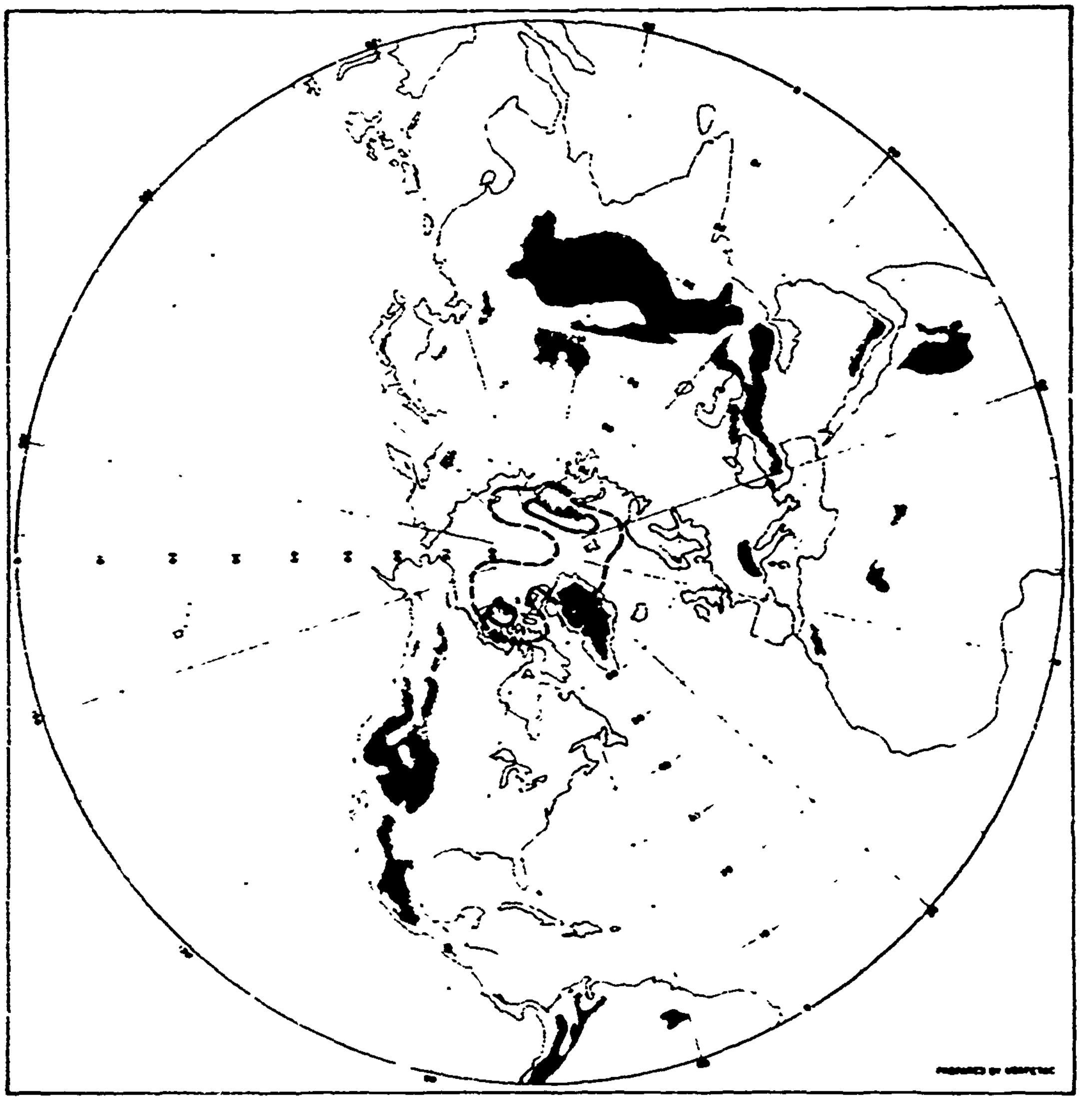
Figure F-24



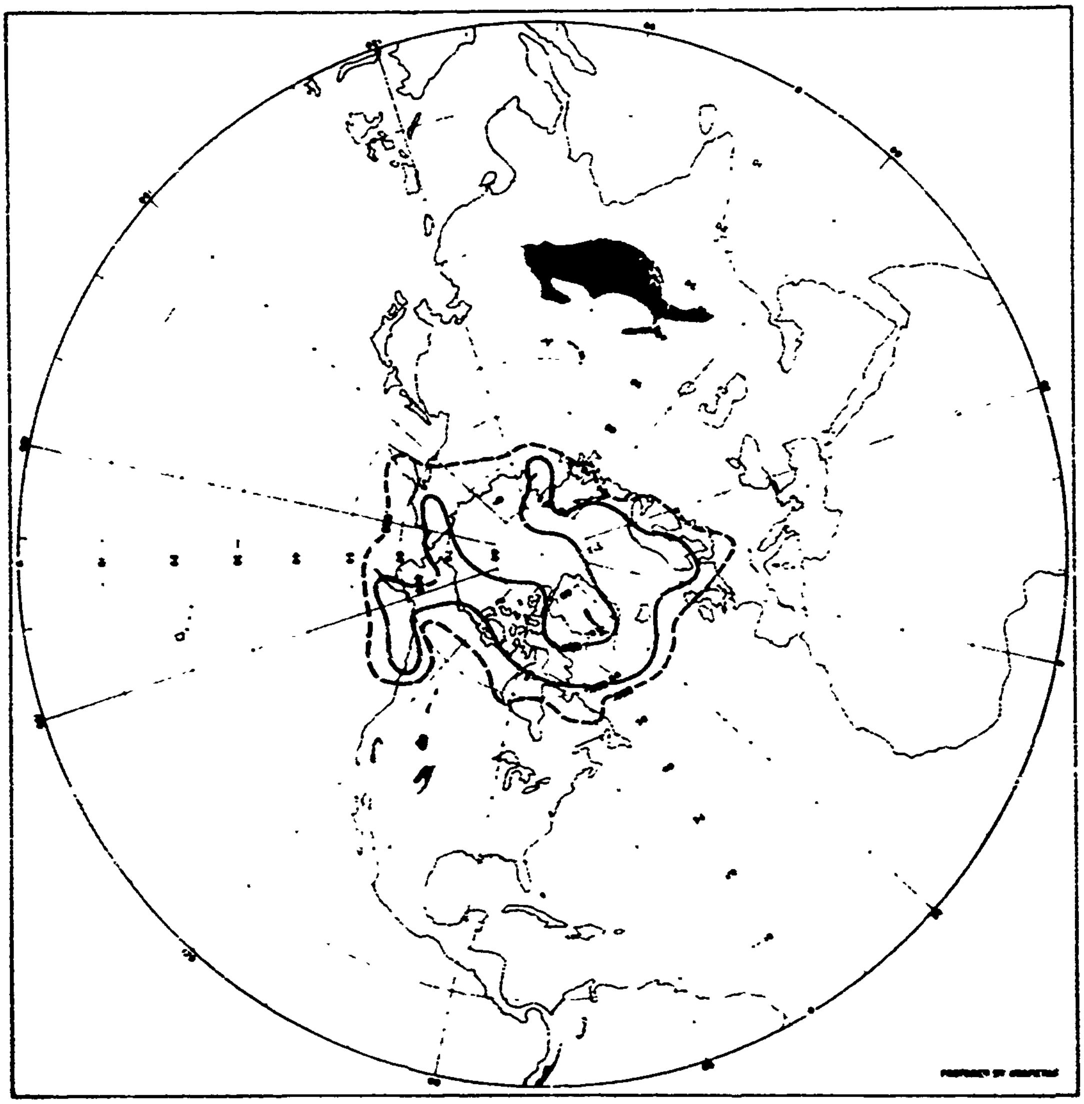
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
1000 MB JULY

Figure B-25



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
850 MB JULY

Figure B-26



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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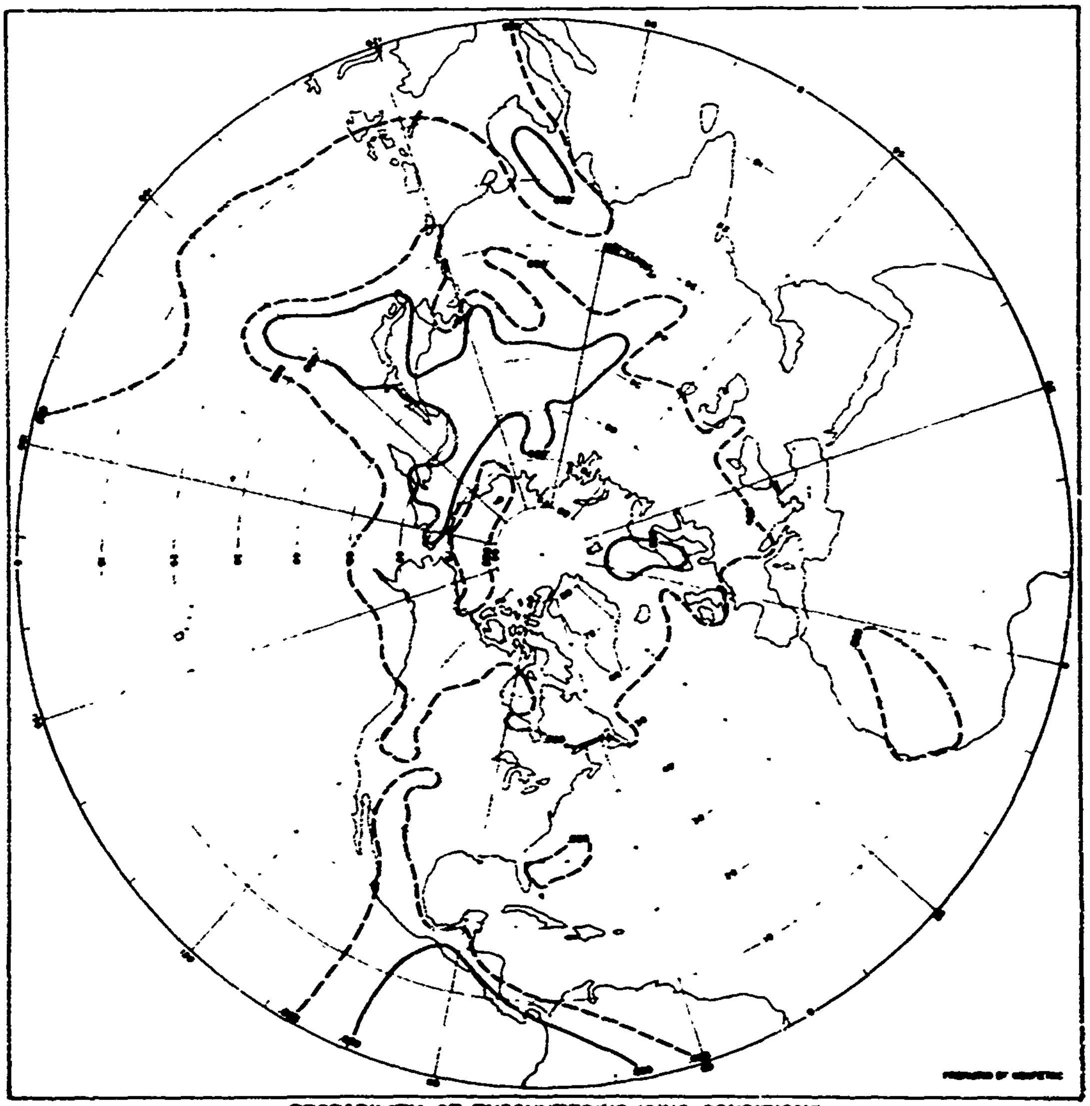
Figure B-27



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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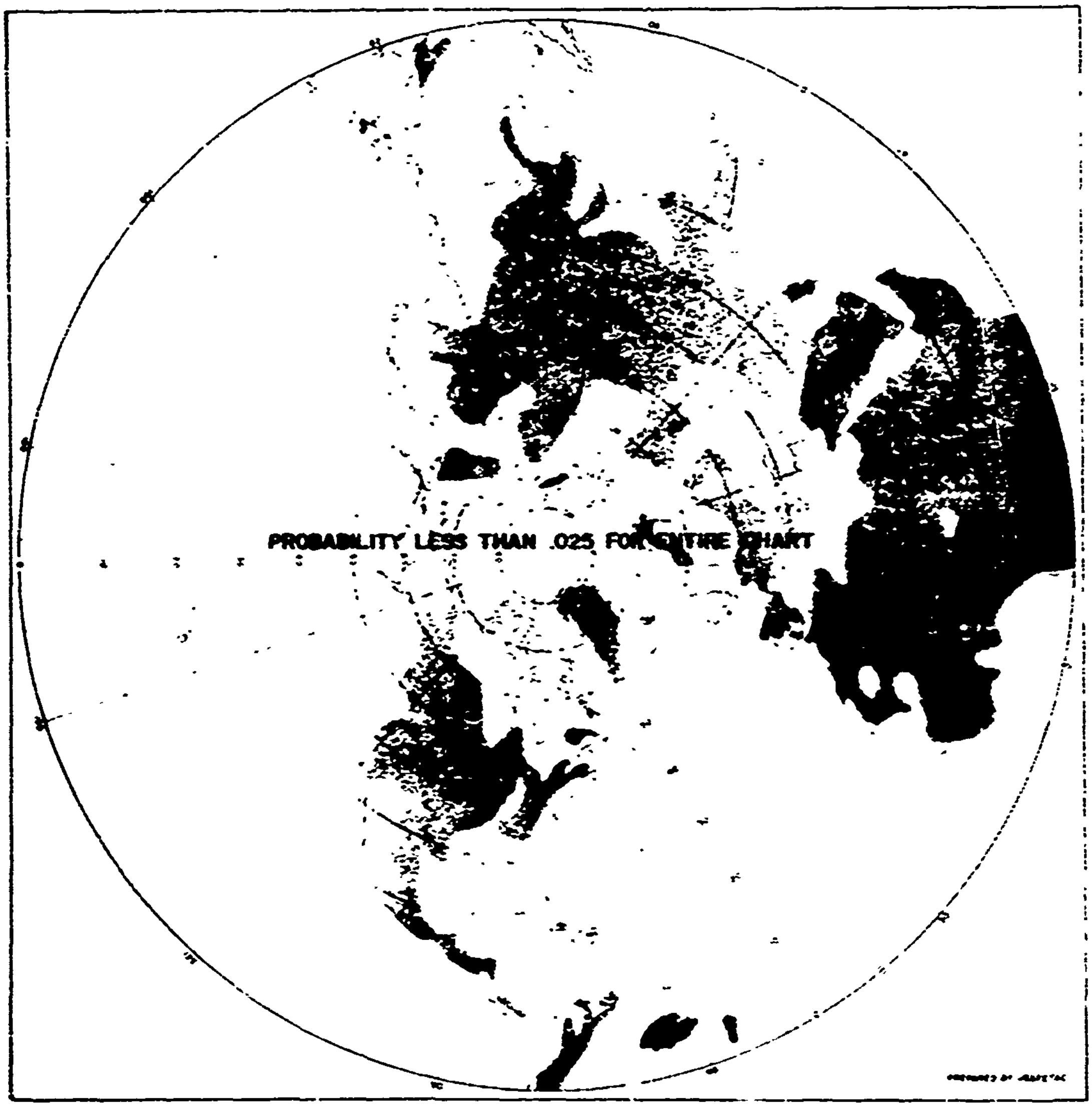
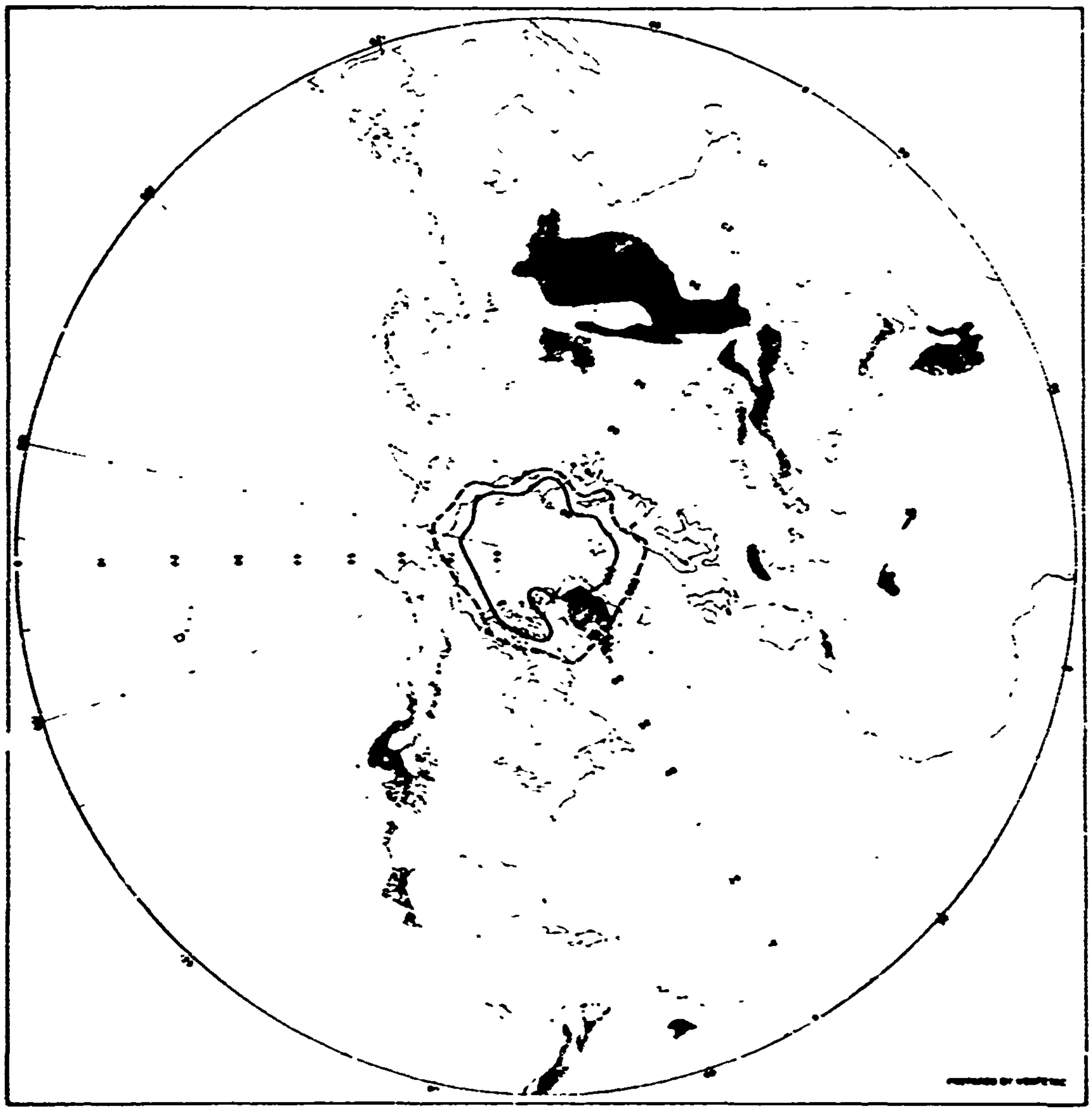
Figure B-28



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
1000 MB AUGUST

Figure B-29



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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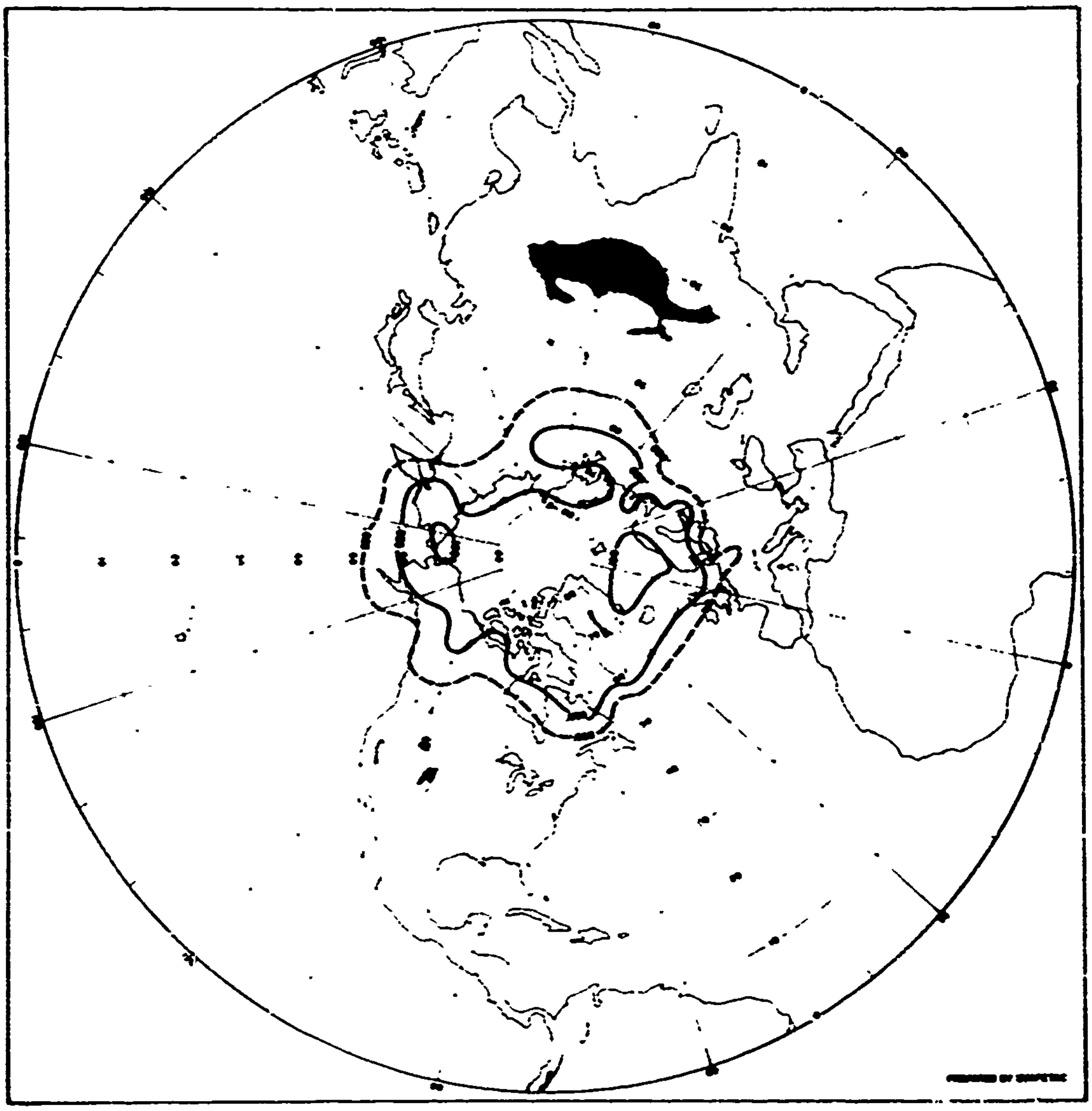
Figure B-30



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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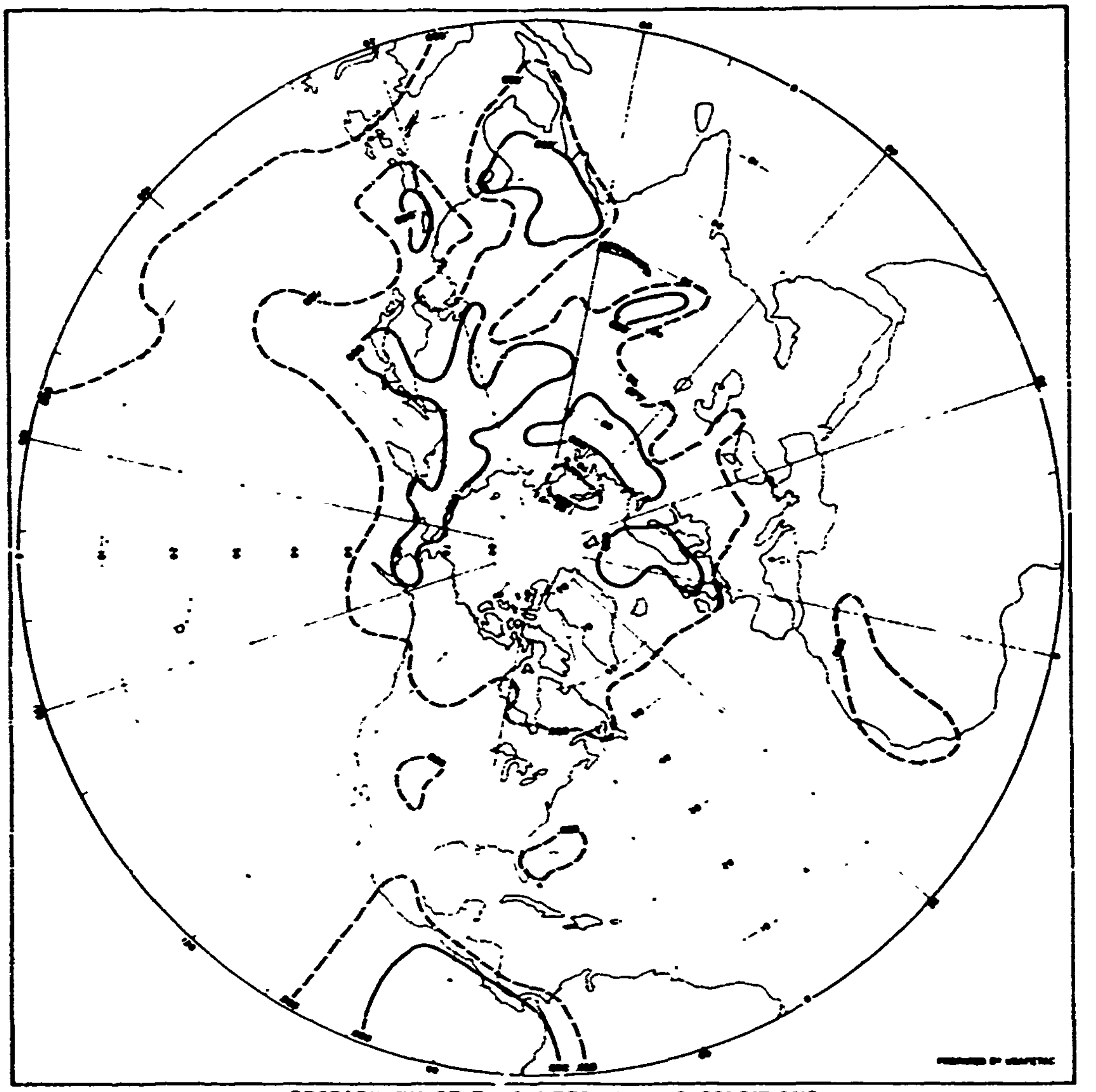
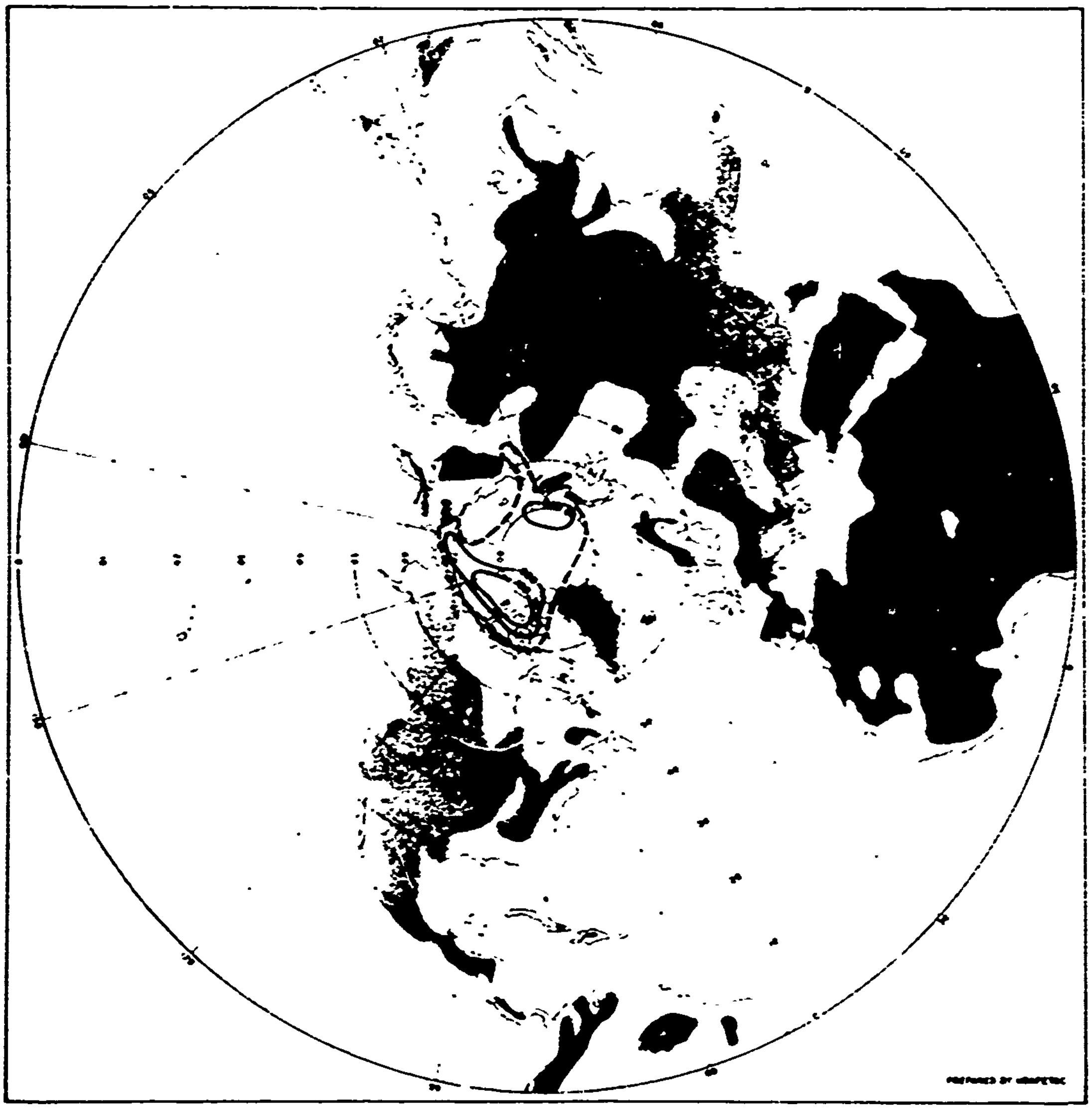
Figure B-31



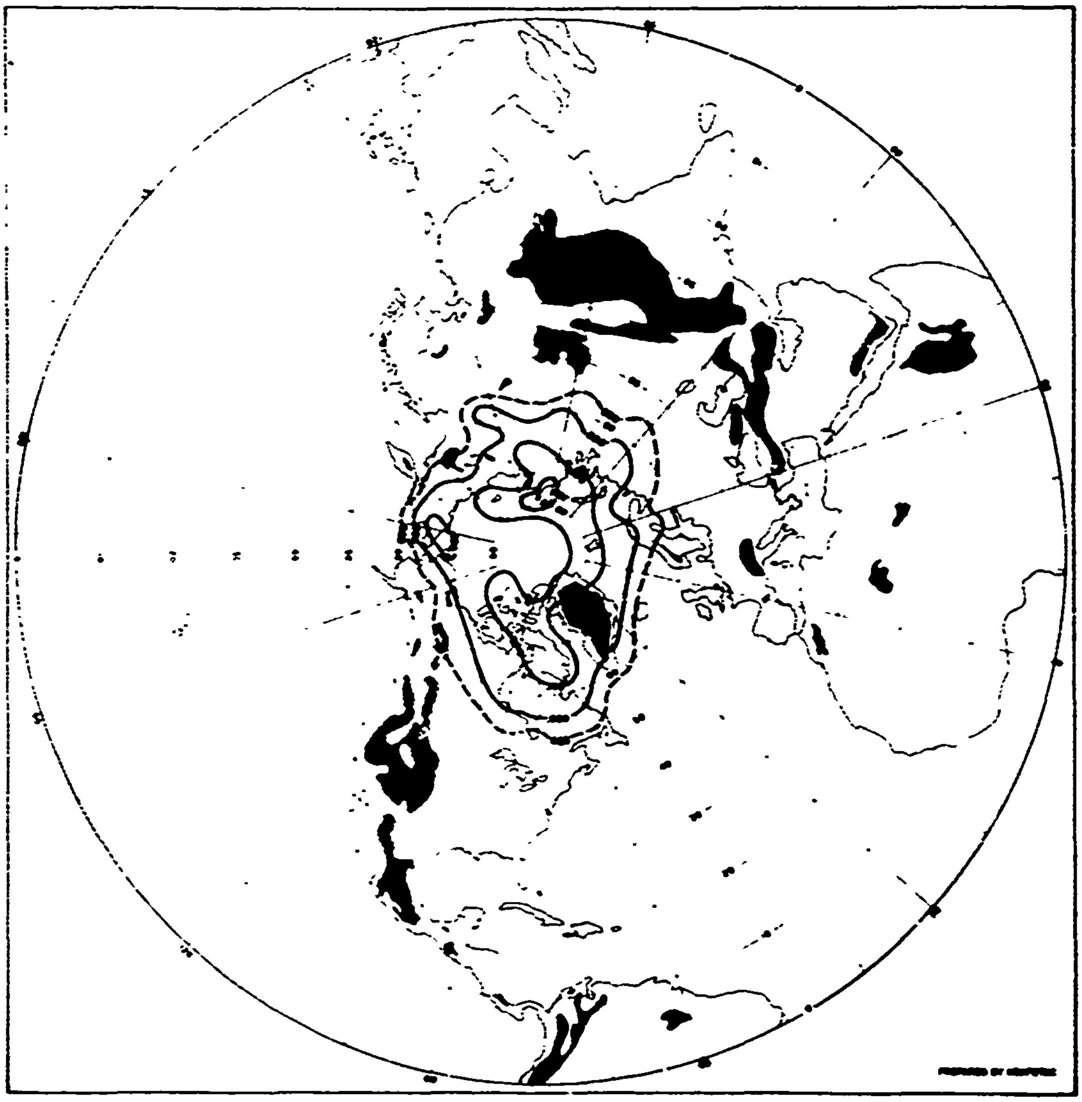
PROBABILITY OF F..COUNTERING ICING CONDITIONS
500 MB AUGUST

Figure B-32



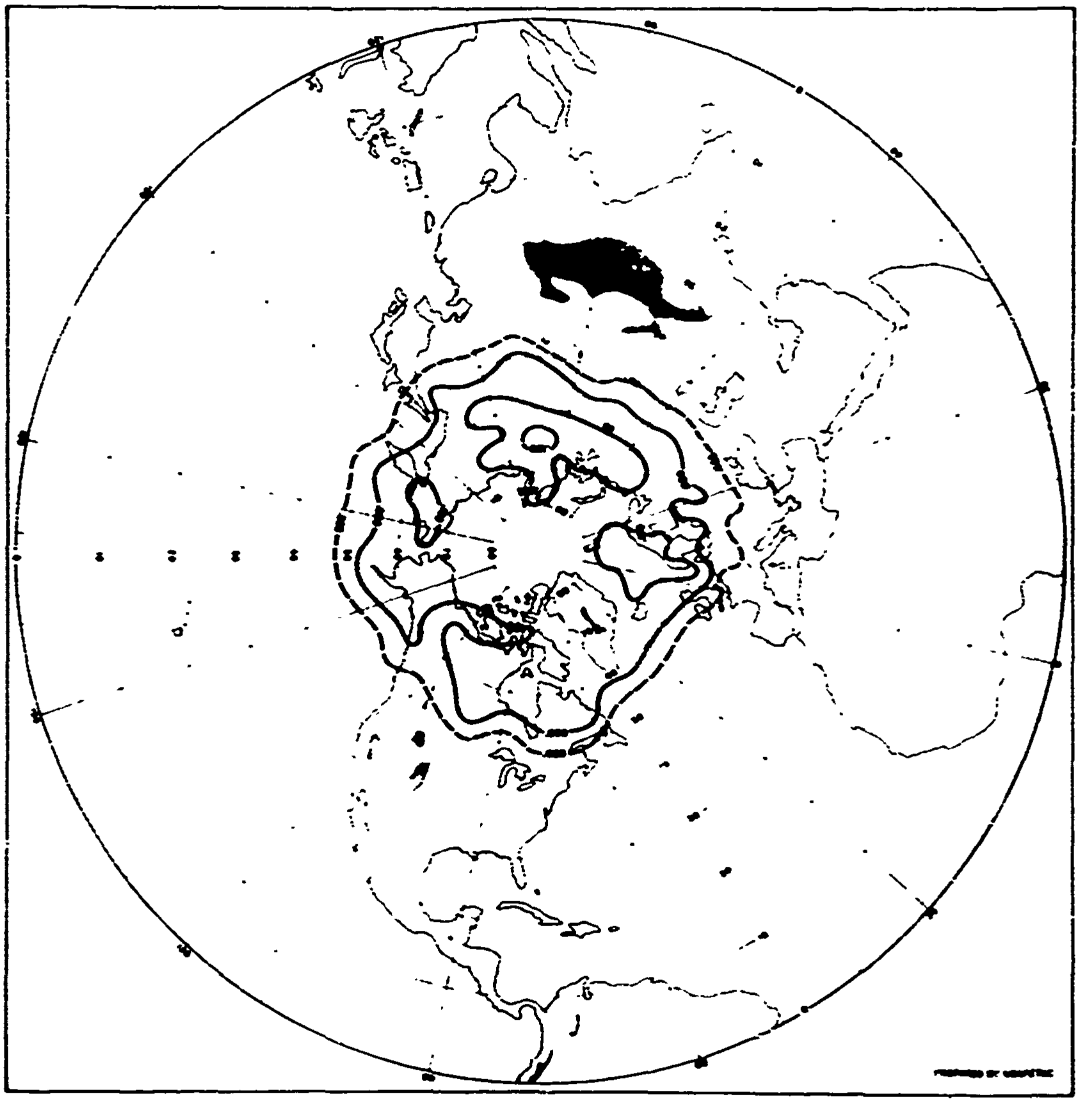
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
1000 MB SEPTEMBER

Figure B-33



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
850 MB SEPTEMBER

Figure 3-34



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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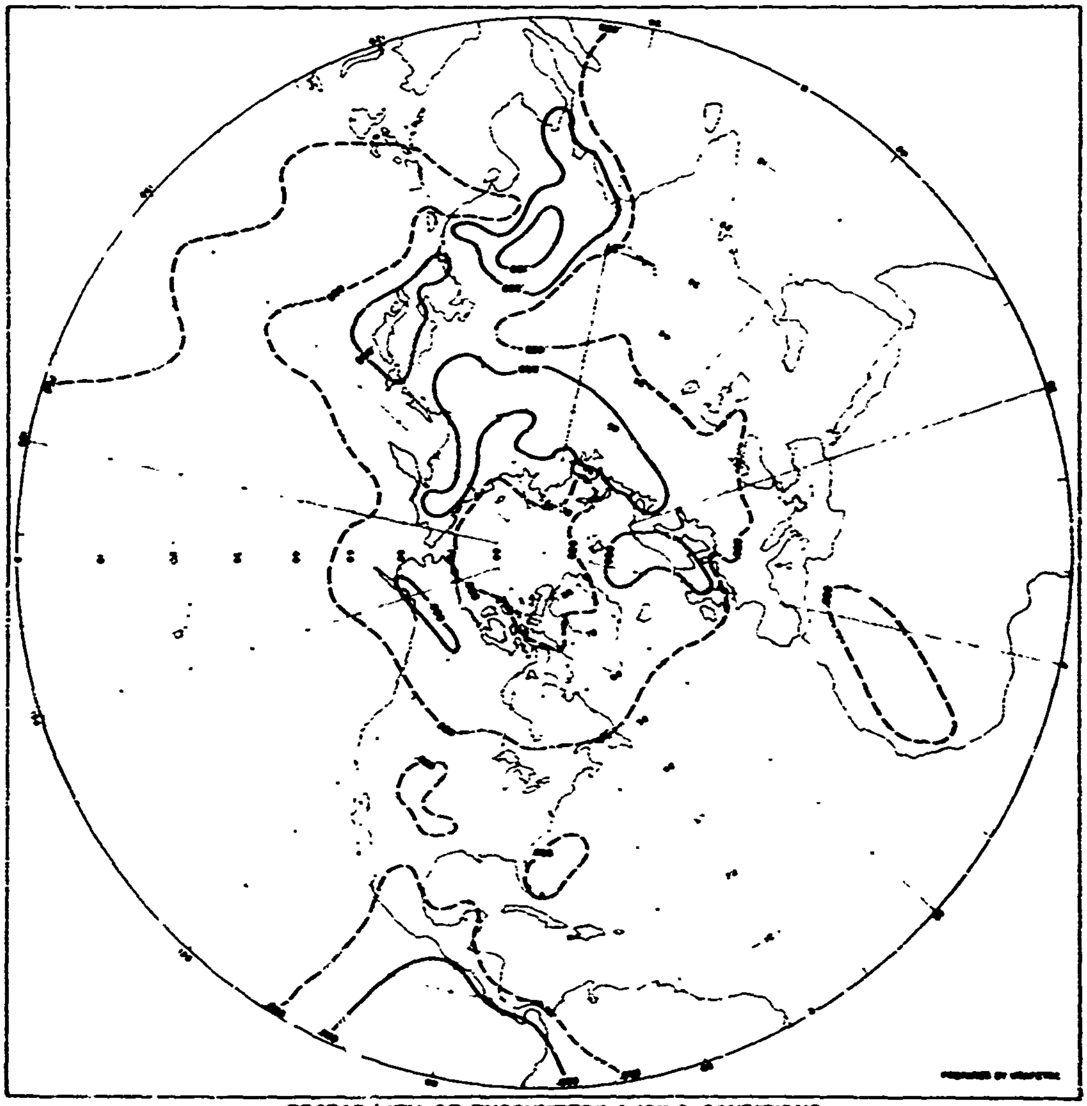
Figure B-35



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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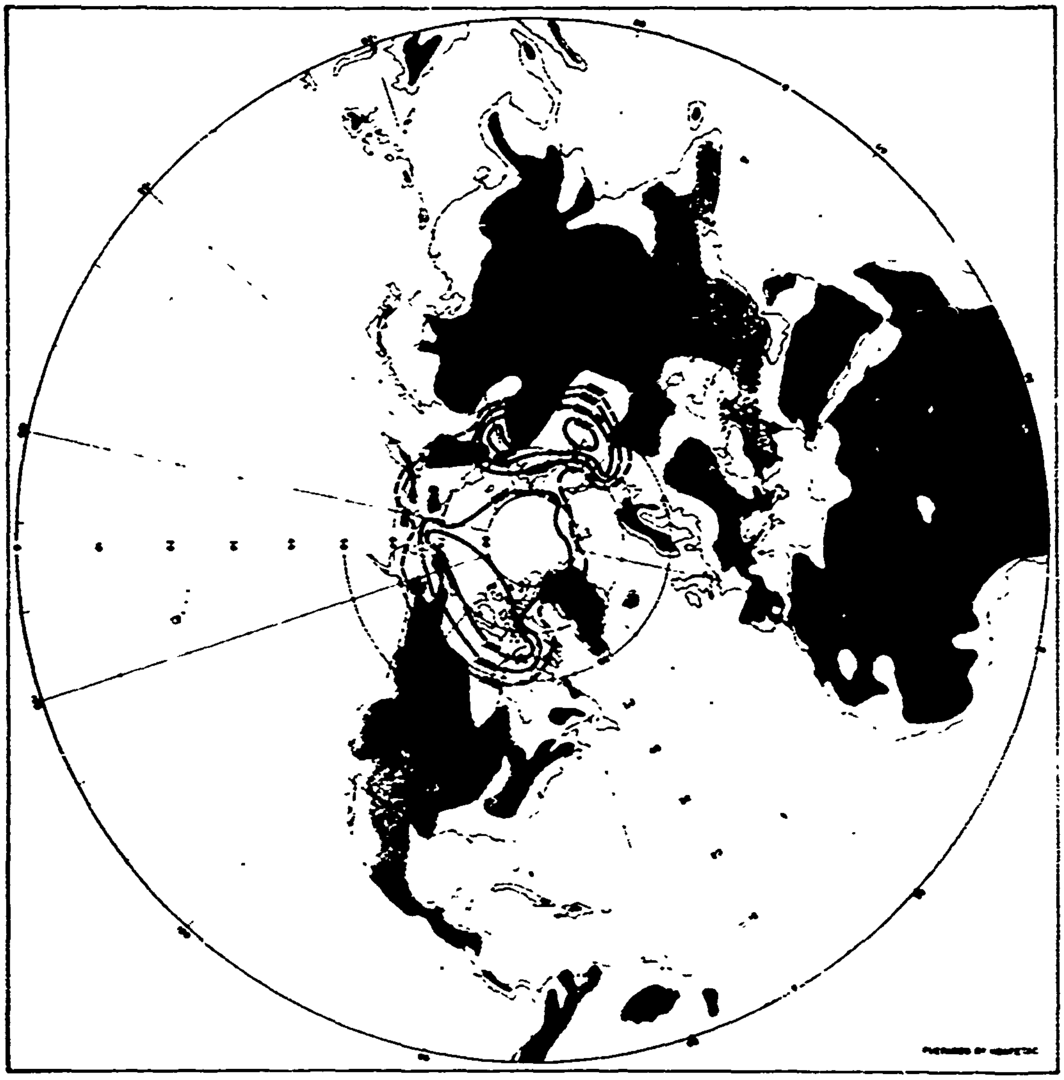
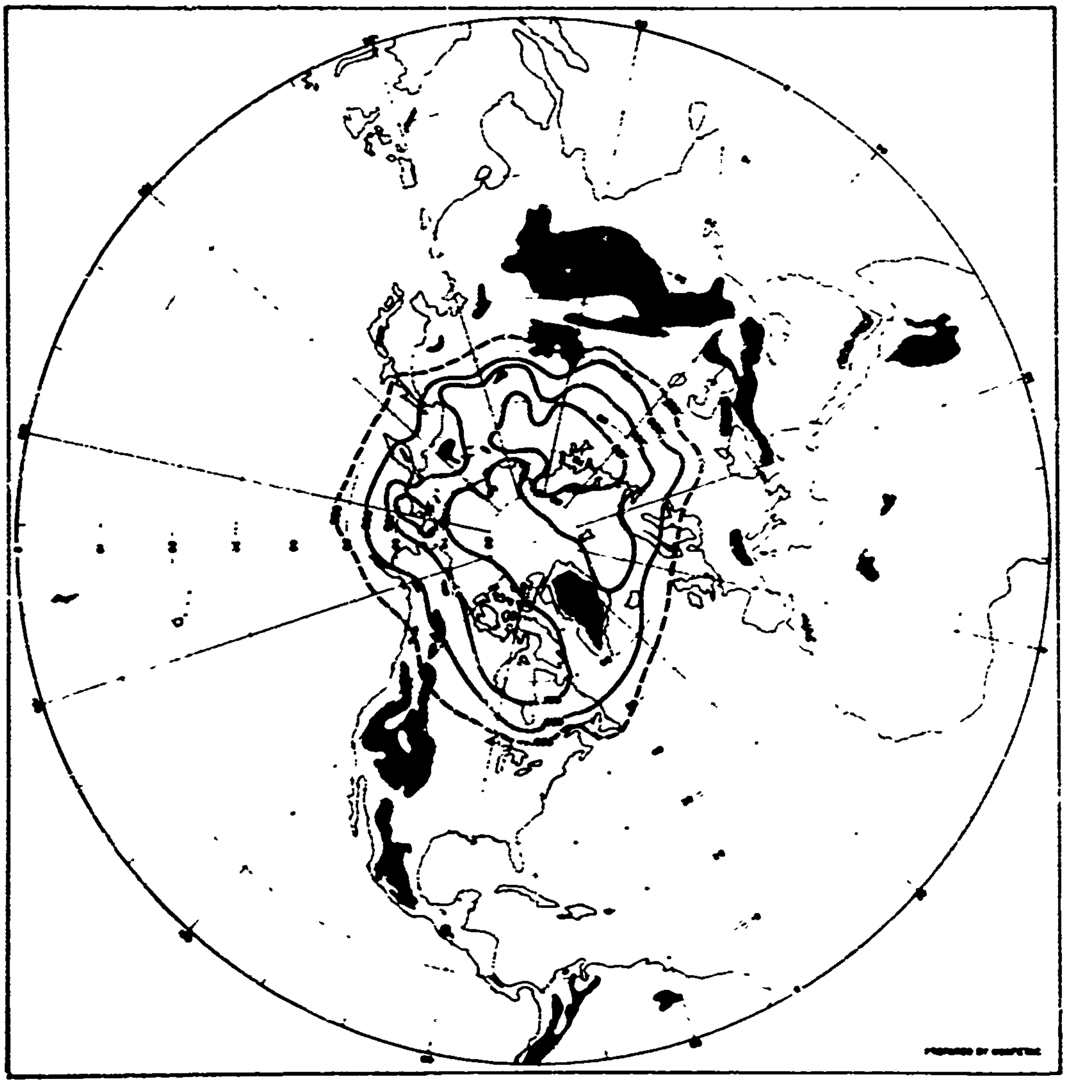
Figure B-36



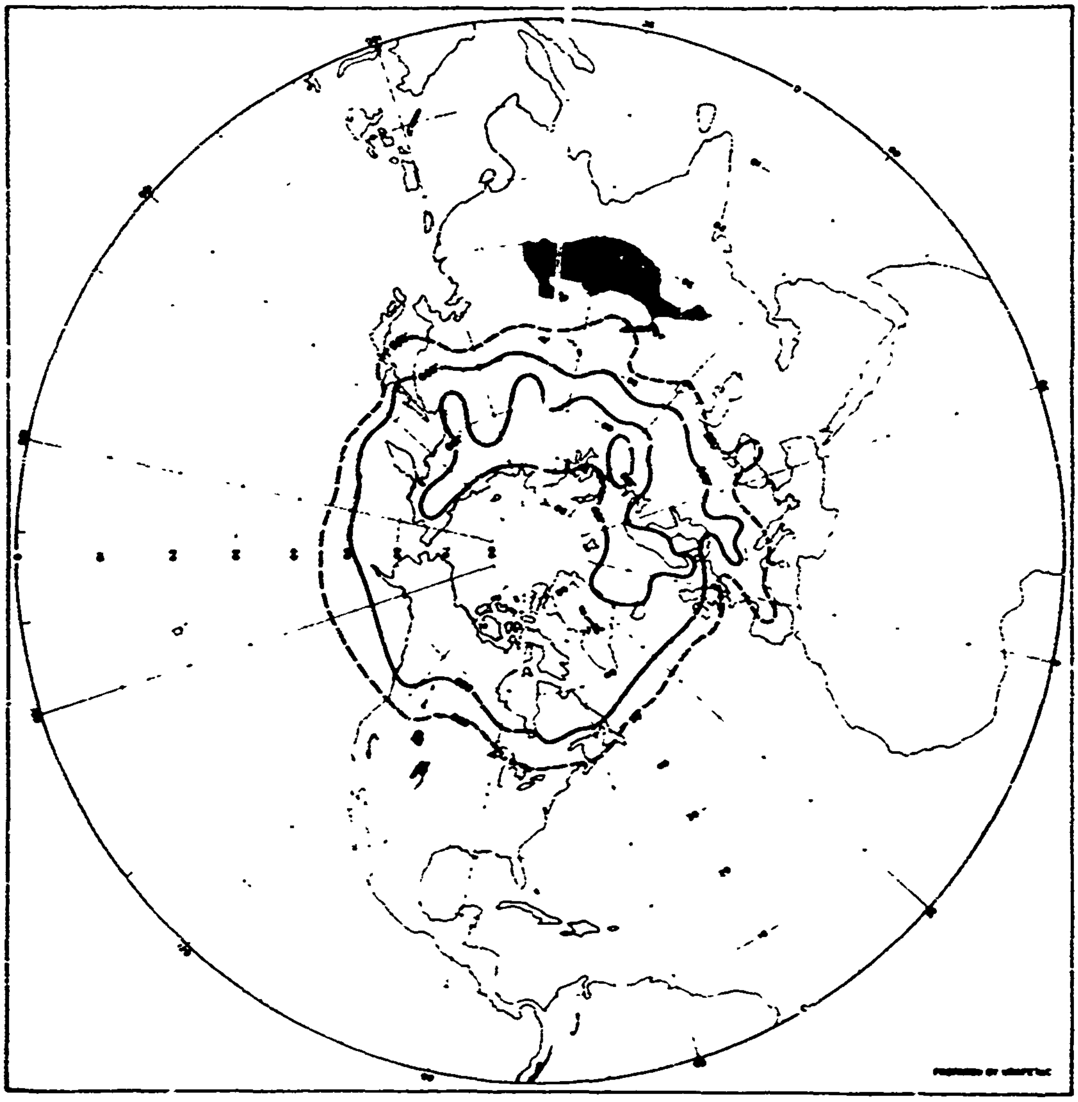
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
1000 MB OCTOBER

Figure B-37



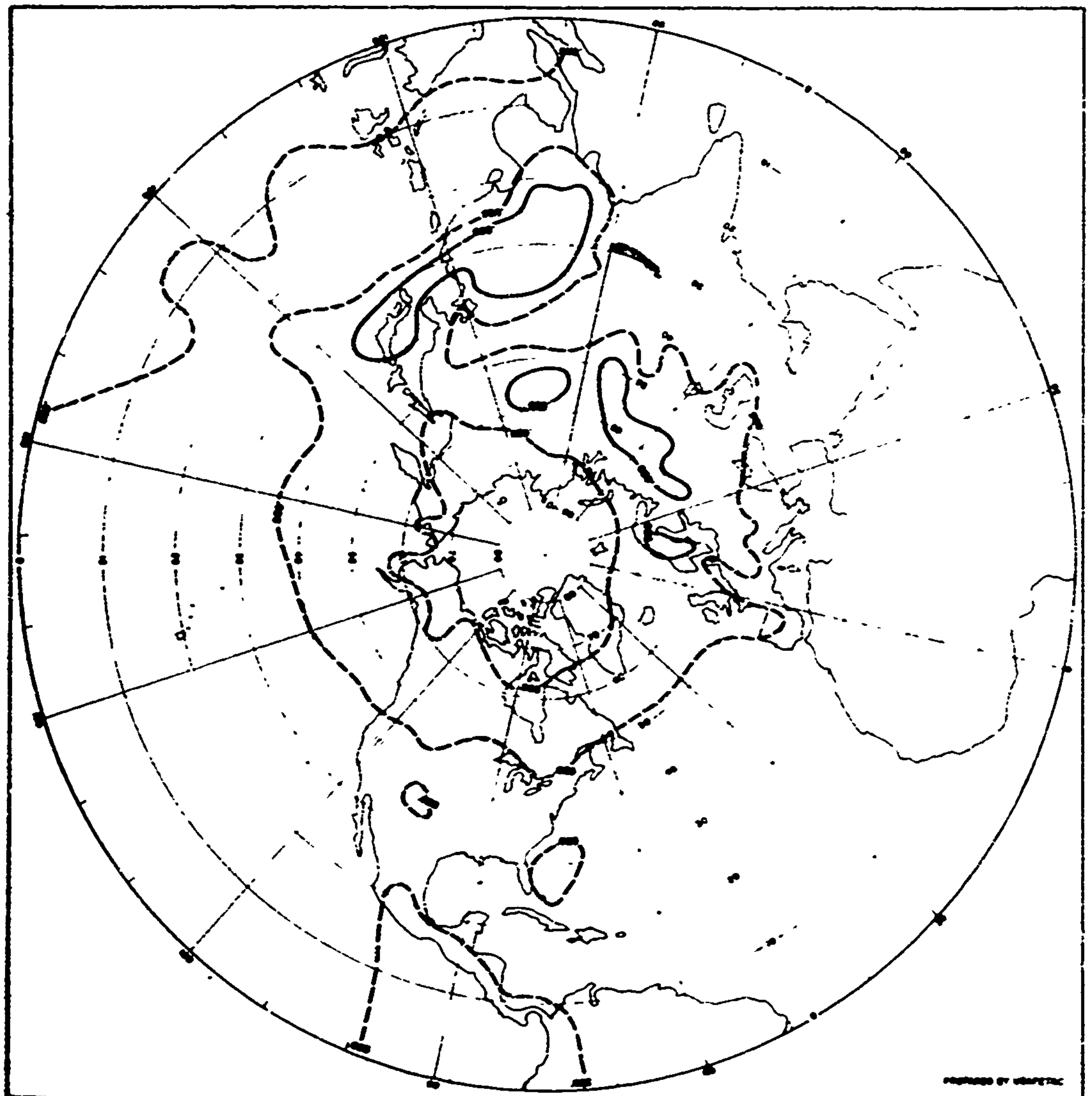
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
850 MB OCTOBER

Figure B-38



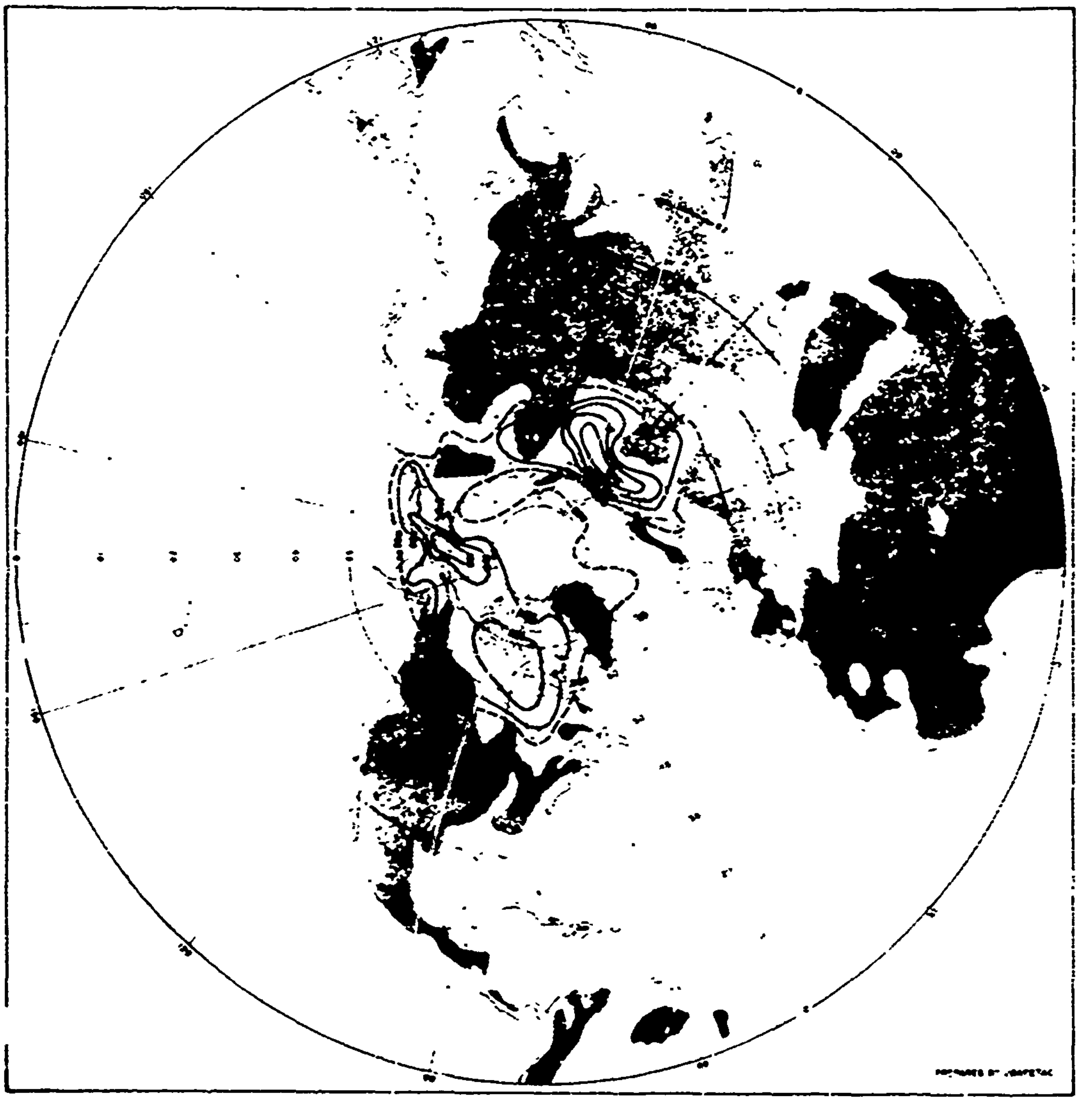
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
700 MB OCTOBER

Figure B-39



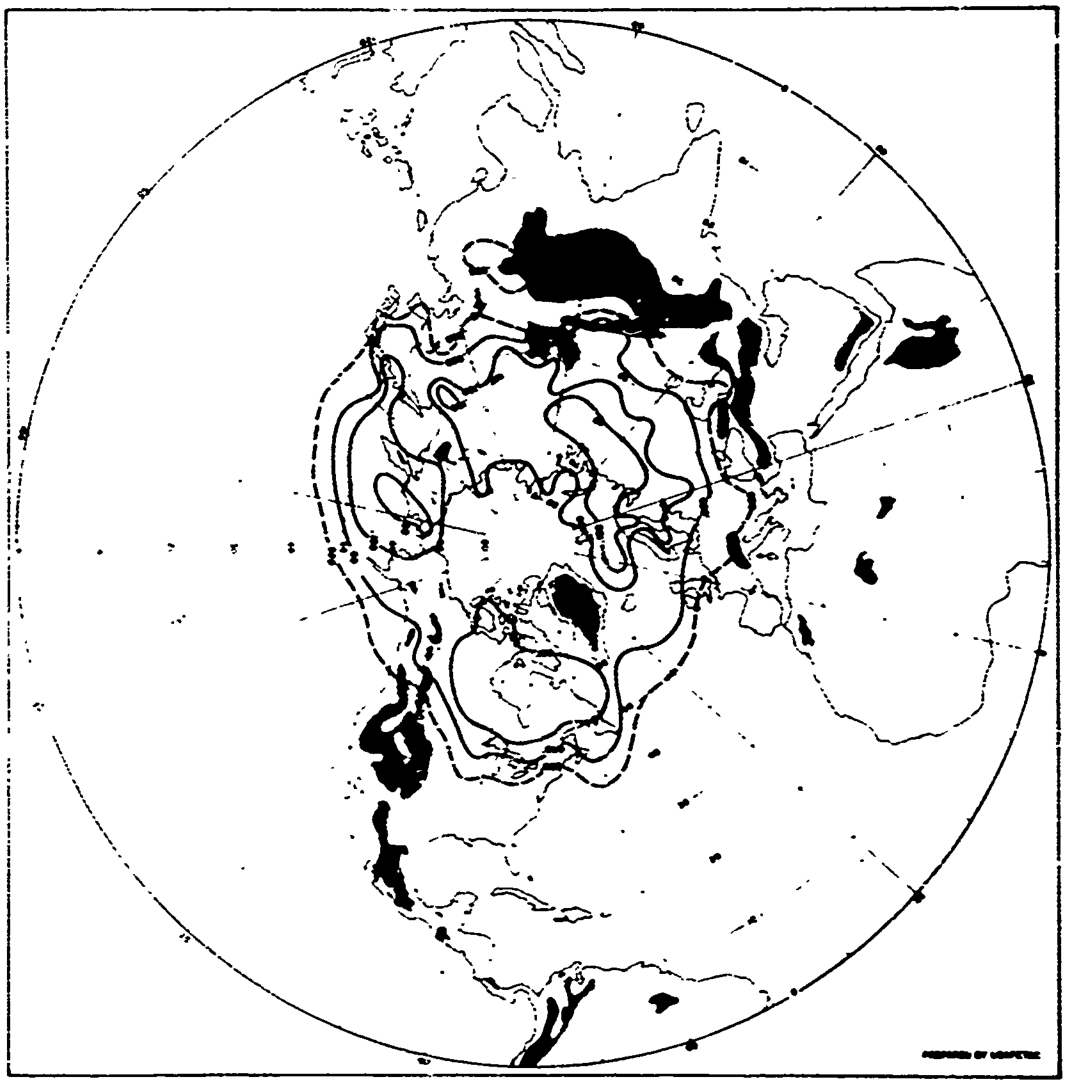
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
500 MB OCTOBER

Figure B-40



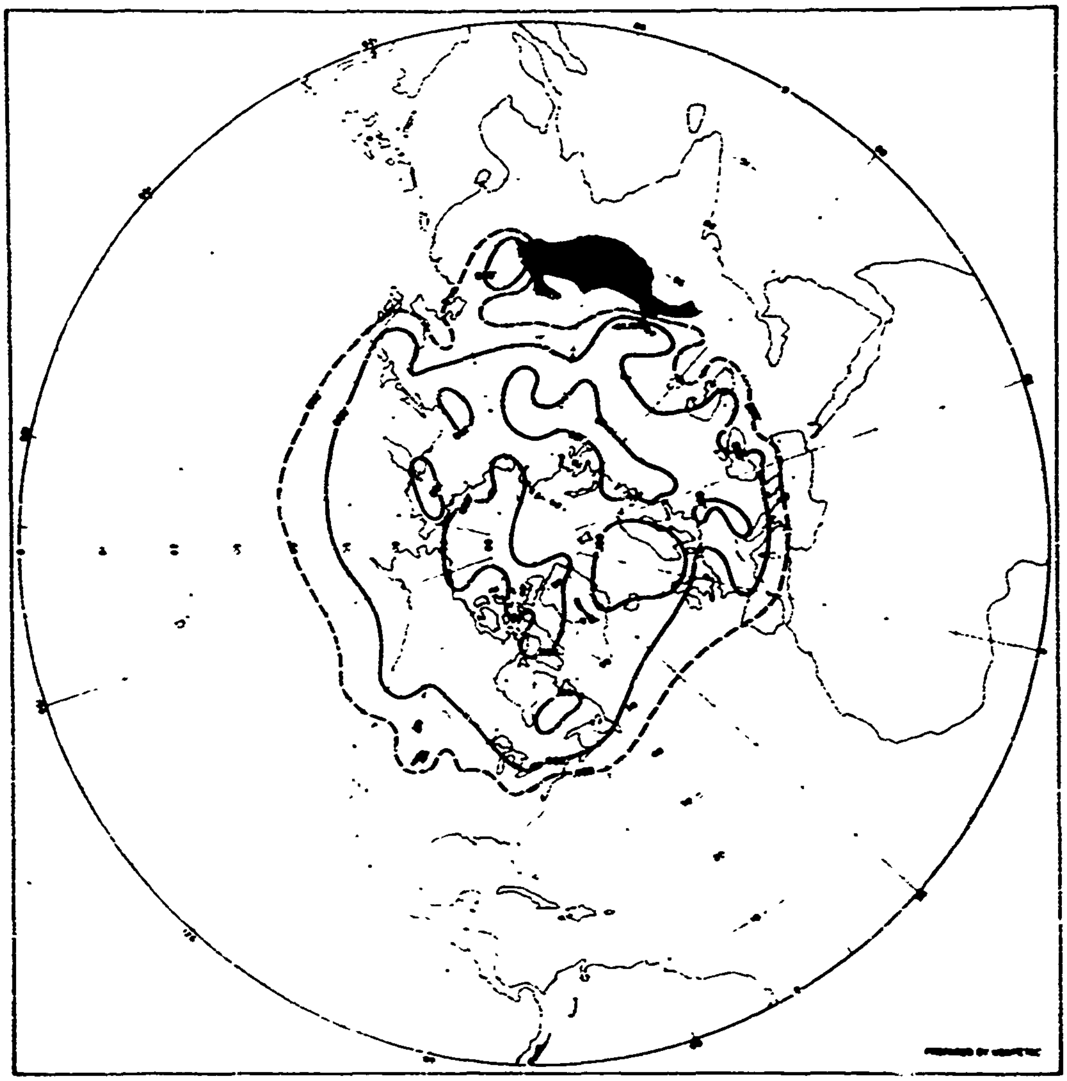
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
1000 MB NOVEMBER

Figure B-41



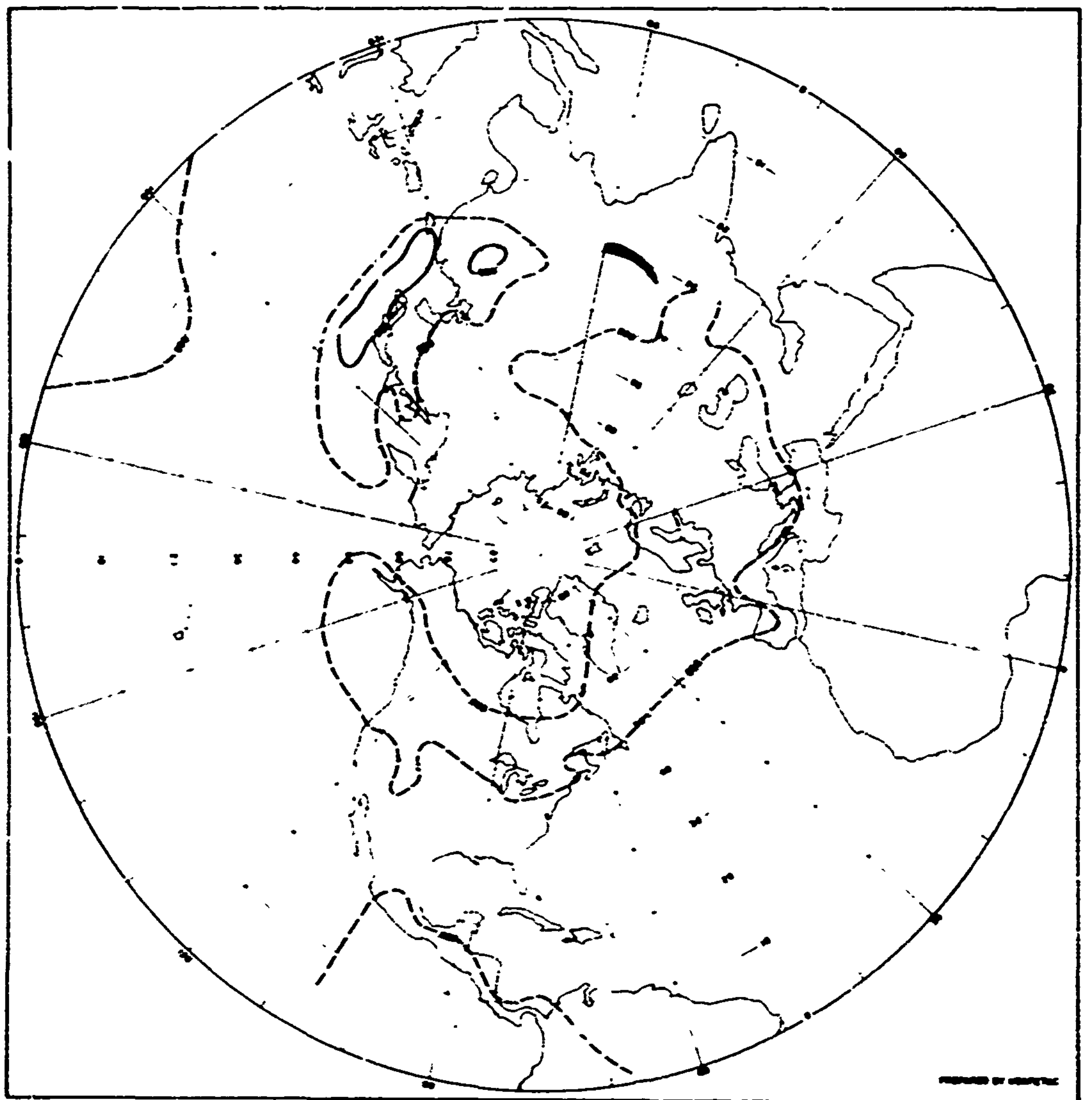
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
850 MB NOVEMBER

Figure B-42



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
700 MB NOVEMBER

Figure B-43



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
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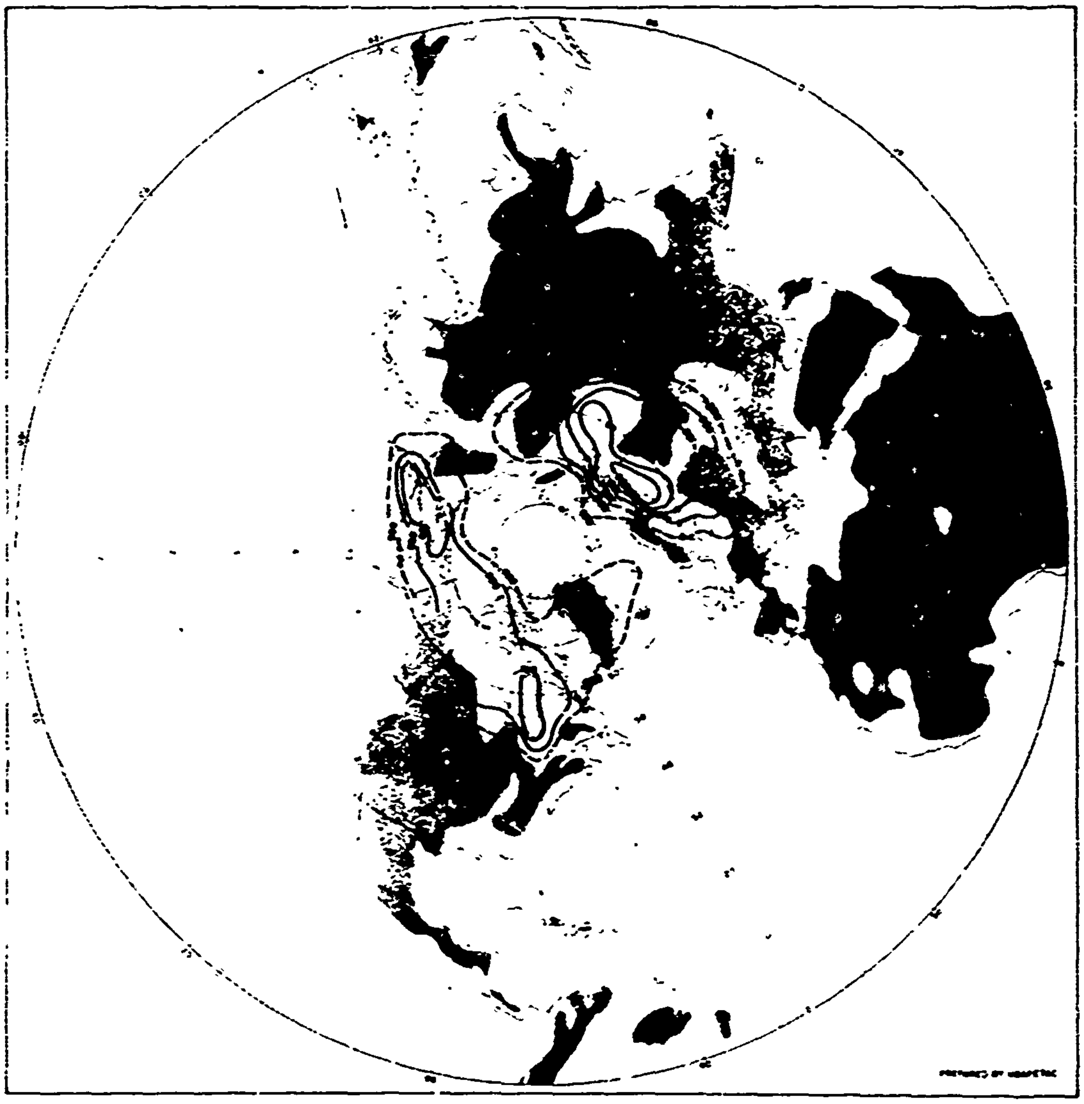
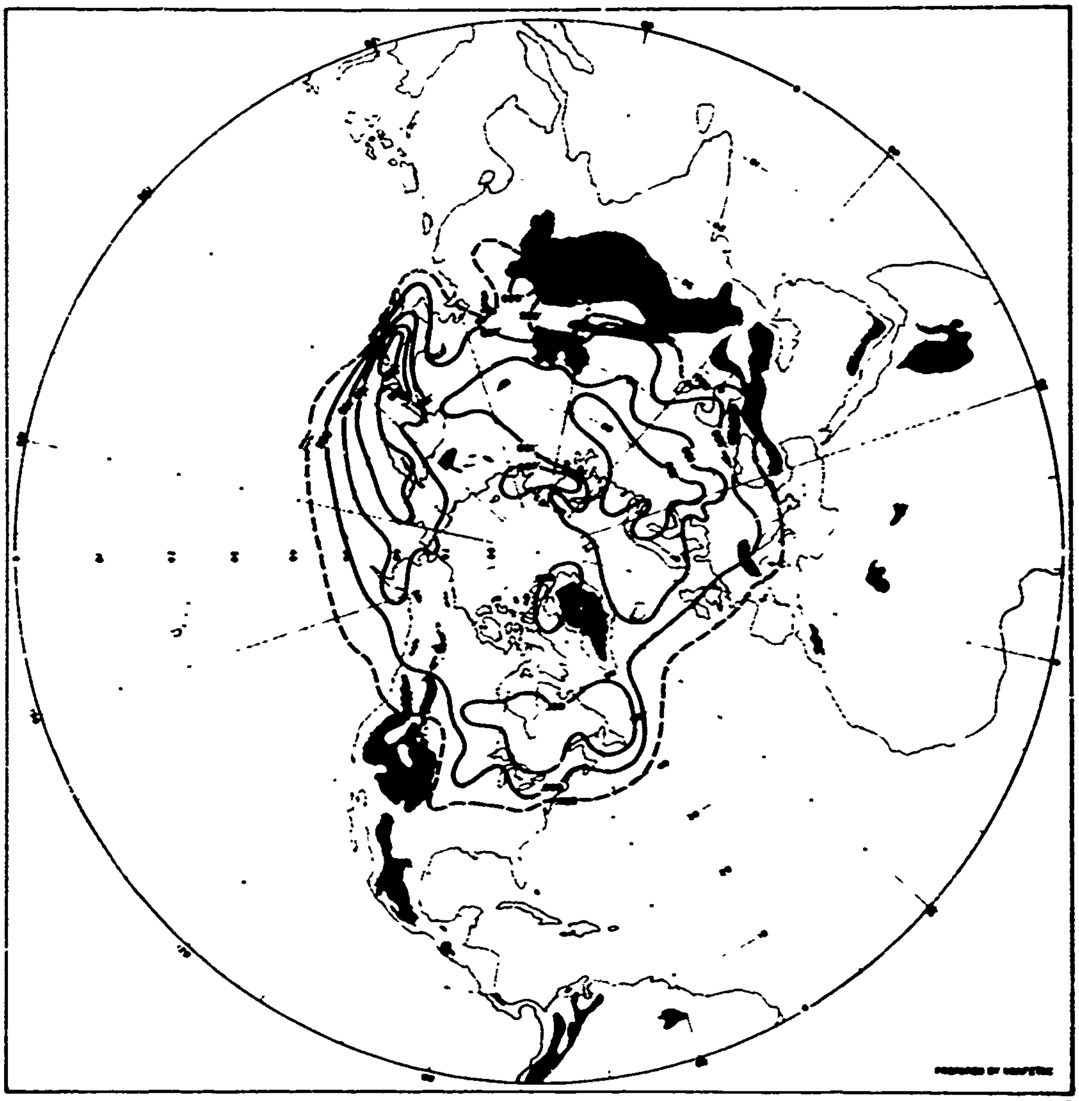
Figure B-44



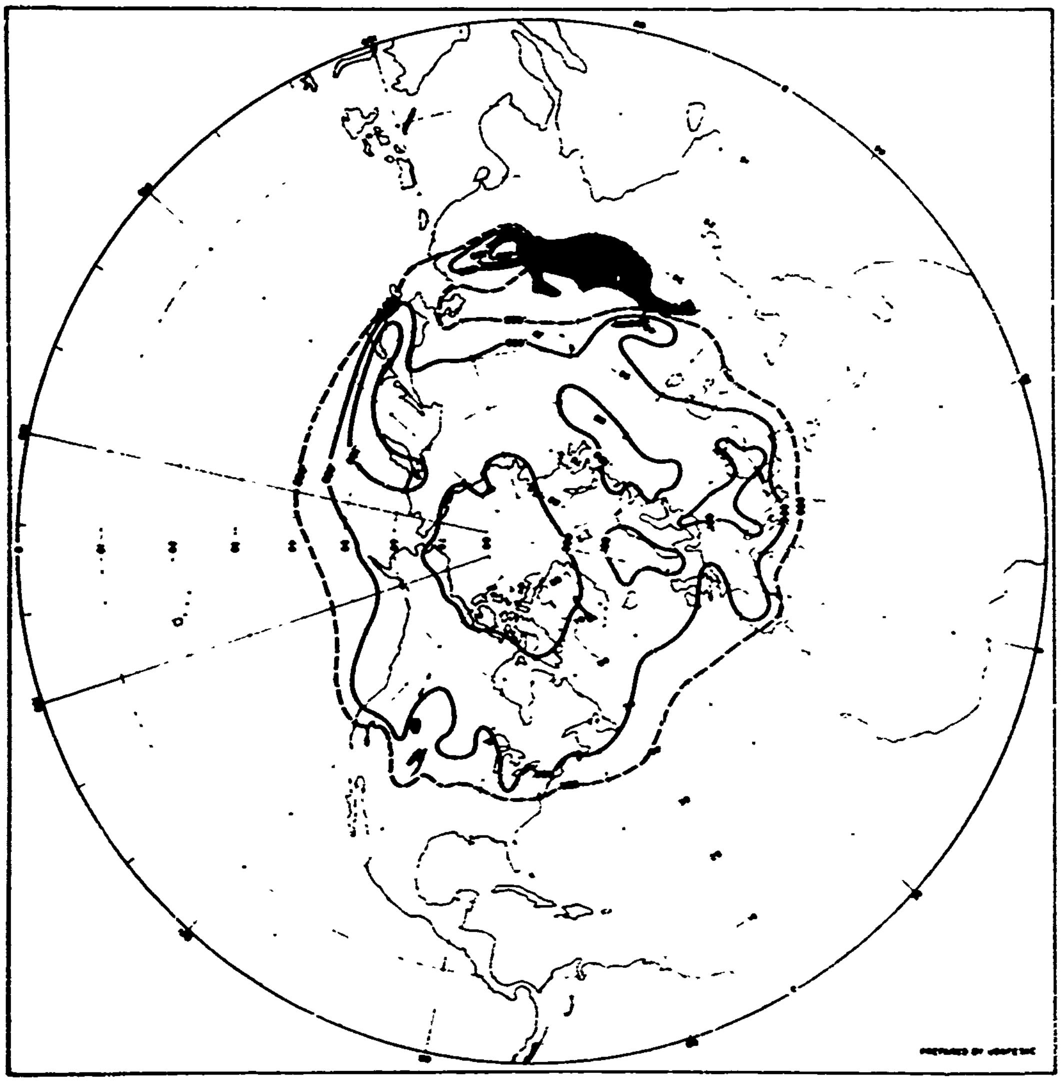
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
1000 MB DECEMBER

Figure B-45



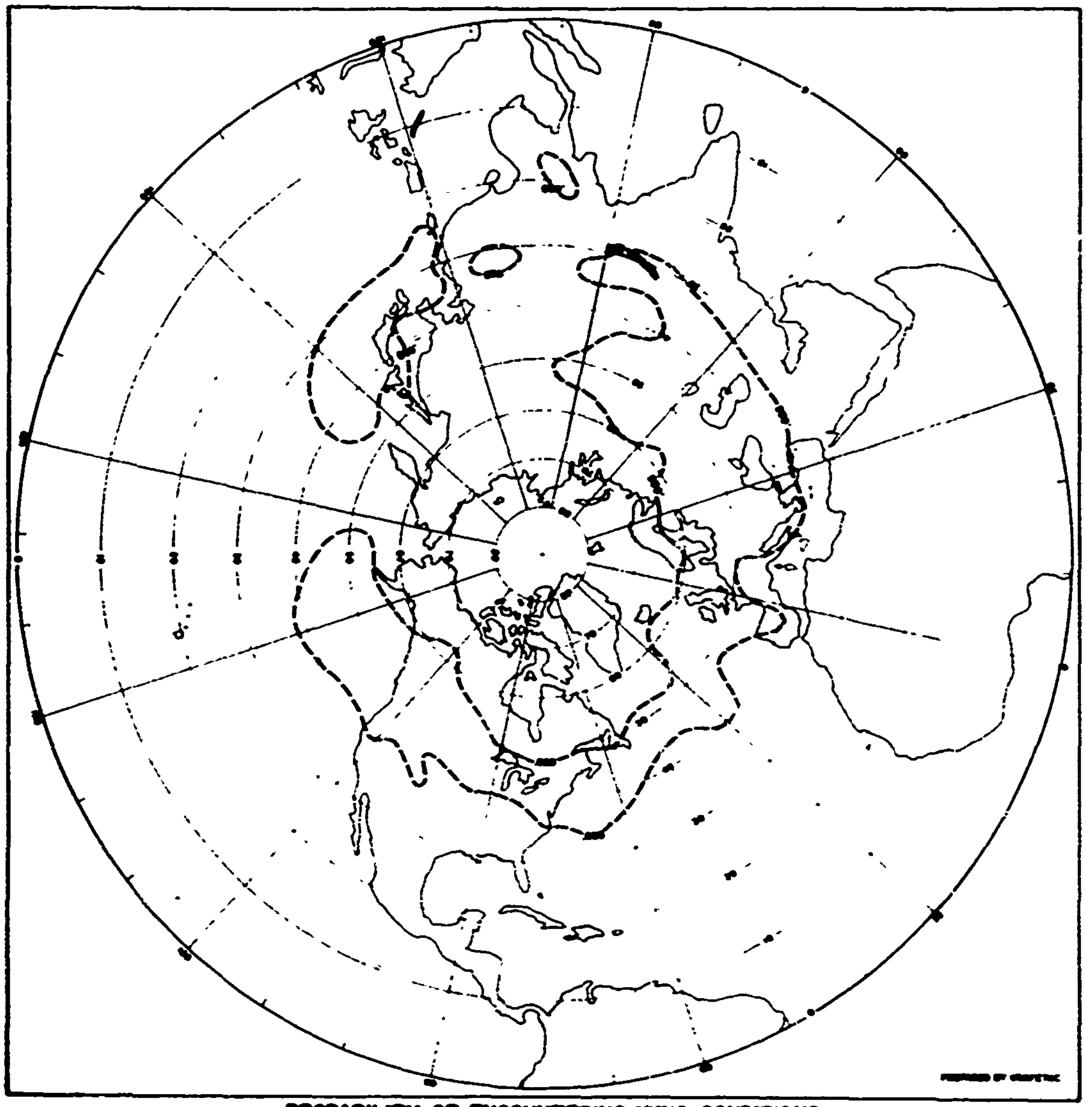
PROBABILITY OF ENCOUNTERING ICING CONDITIONS
850 MB DECEMBER

Figure B-46



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
700 MB DECEMBER

Figure B-47



PROBABILITY OF ENCOUNTERING ICING CONDITIONS
500 MB DECEMBER

Figure E-48